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Subject: IGSCE CIE Design Technology

MAJOR PROJECT



CONSIDERATION OF DESIGN NEED

The following pages will show the:

1. Design Problem
2. Design Situation
3. Client:
 - 3.1. Profile
 - 3.2. Needs and Wants
 - 3.3. Requirements and Specifications
4. Design Opportunities
5. Target Market
6. Design Brief



Client - Nety Sahai

CLIENT

NAME: Nety Sahai

AGE: 46

OCCUPATION: Housewife

RESIDENCY: Central Singapore

NATIONALITY: Indian

Nety Sahai has 2 children (older son and younger daughter). Her son, Aryan Sahai, is 17 years old and will be sitting his final exams soon.



Aryan using his phone instead of studying

DESIGN PROBLEM

Nety Sahai's son constantly uses his mobile phone during the time when he should be studying for his exams. Despite Nety's efforts of **hiding Aryan's phone** in **different places** around the house, Aryan still eventually finds his phone. Therefore, my client is required to keep **constant surveillance** on the phone.

DESIGN SITUATION

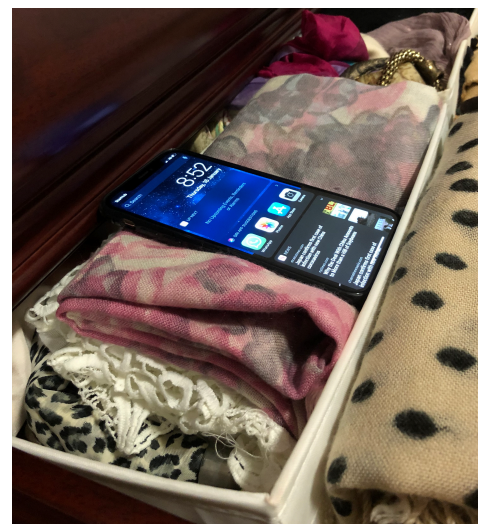
Nety Sahai often keeps Aryan's mobile phone far away from him, in **different places around the house**. These are **some** places that Nety hides Aryan's phone (**current solution**):



Behind Books



Under the Keyboard Cover



In between her clothes

The environment that Nety wants the solution to go in is her bedroom. This way Aryan will not constantly check the time remaining for his phone to be released. The interior design of this space is **traditional** with a **large incorporation of mahogany and teak furniture**. The product will be placed on my client's bedside table. In order to match the classic style of her bedroom, Nety wants a product that will **complement the brown colour** of the side table.



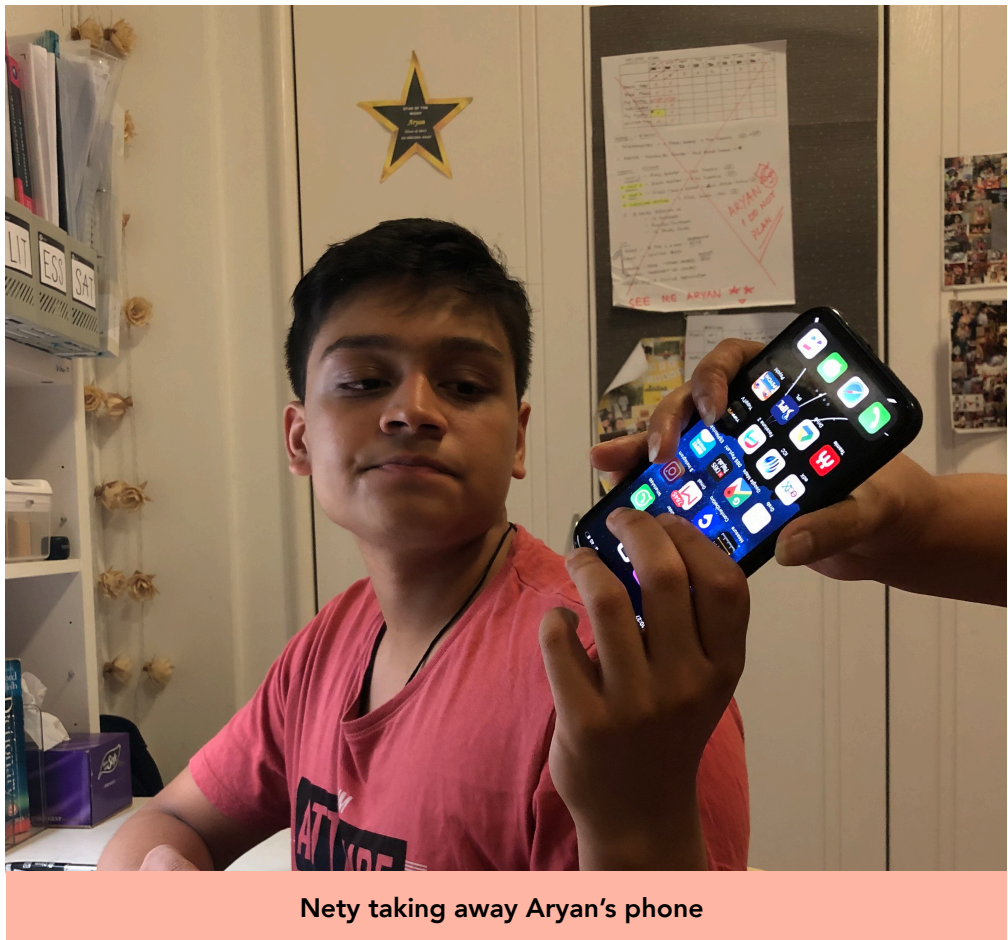
Environment of Solution - Bedroom (bedside table)

CLIENT - NEEDS & WANTS

NEEDS	WANTS
• Should include a lock .	• Complement the brown colour of the coffee and side tables.
• Should be locked for a predefined amount of time so that Aryan cannot steal the phone back.	
• Should be able to fit and hold Aryan's specific phone model (iPhone X).	• Compact to fit on the bedside table.
	• Lightweight to carry around and place on different furniture when needed.

DESIGN OPPORTUNITIES

She requires a place where her son's phone can be **securely locked**. It must be ensured that Aryan can only take his phone back when Nety allows him to after he **finishes studying**. My client's current solution to this problem is to constantly **change the location** of where she keeps the phone, however her son **eventually finds** his phone again. This solution is also **tiresome** for Nety as she **constantly** has to **find new places** to hide his phone.



Nety taking away Aryan's phone

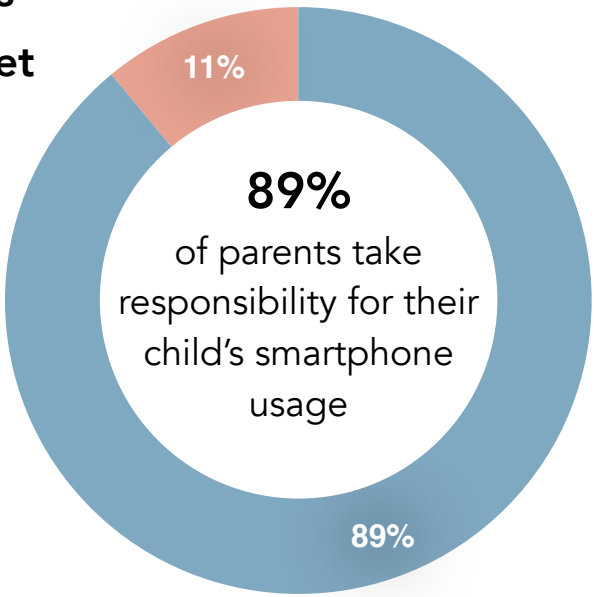
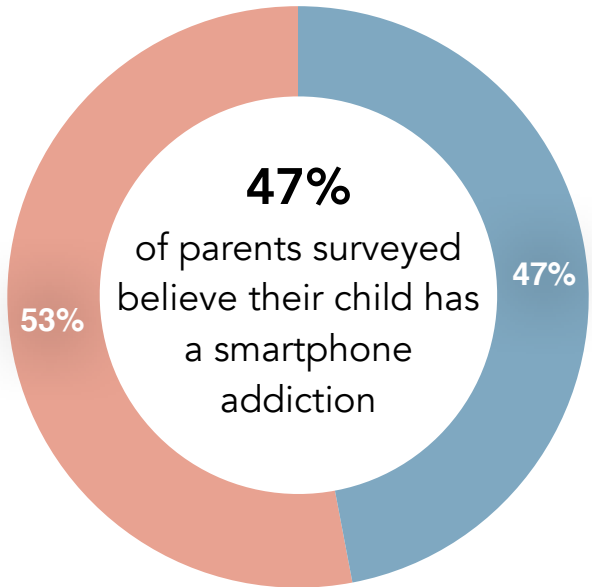
CLIENT - REQUIREMENTS & SPECIFICATIONS

PURPOSE	- Securely keep Aryan away from his phone - Allow Aryan to focus on his exams
FUNCTION	- The phone box should have the ability to get locked and opened - It should fit Aryan's iPhone X - Nety should be able to adjust the amount of time she wants the box to be locked for
SIZE	Lightweight and compact to easily carry around and place on different furniture
AESTHETICS	Complement the Brown colour of the bedside table - Match the traditional and classic style of the room
ENVIRONMENTAL	Going to be situated in Nety's bedroom
MATERIALS	An element of wood to conform with the furniture

TARGET MARKET

Teen cell phone addiction is a substantial issue today. Statistics from [slicktext.com](https://www.slicktext.com) inform us that many households face the same issue that Nety faces.

This product can be used by parents like Nety who get stressed and upset over monitoring the usage of their child's phone.



This design allows parents to take control and abolish the addiction of today's youth.



Aryan addicted to his phone

DESIGN BRIEF

I propose to design and manufacture a **time based phone box** as a solution to my client's problem. This design is required, because Nety needs a product which **securely locks** Aryan's phone, and a product that **locks the phone for a desired amount of time**. The phone box will be used to **store Aryan's phone** and therefore it is required that the **product must fit in an iPhone X and be strong to hold its weight**. The phone box should be **compact** to fit on my client's bedside table and **lightweight** for Nety to carry and place on different furniture when needed. The product will be placed on Nety's bedside table for majority of the time, and therefore should be **aesthetically pleasing** with features that **complement the brown colour** of the table. My client's **budget is \$40**. This product needs to be **completed by March 2021**.

- C1
- C2
- C3
- C4
- C5
- C6
- C7

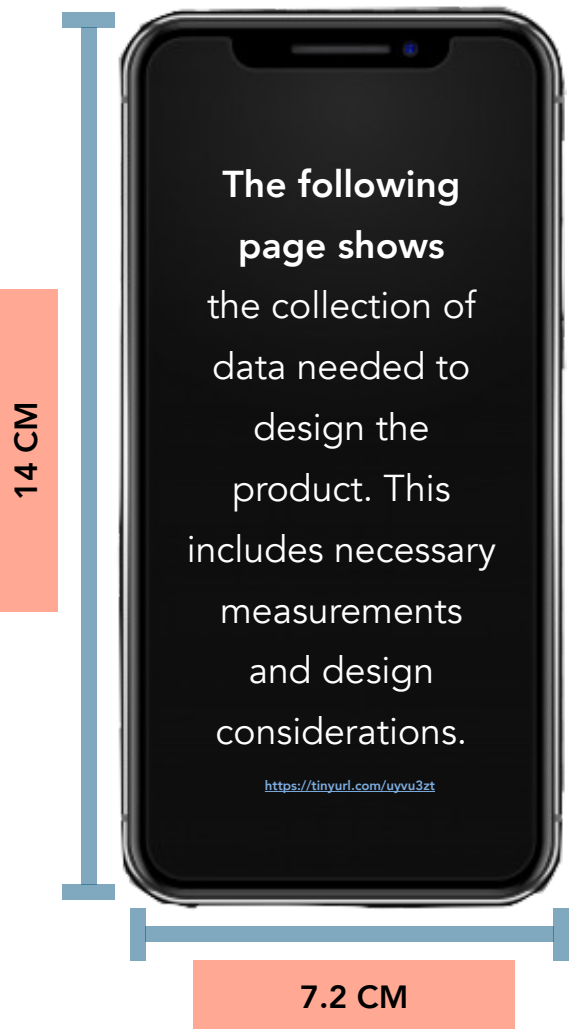
RESEARCH: PRODUCT ANALYSIS

The following page shows the products available on the market and the comparison between each one. This will allow me to analyse the different options I can use to fulfil my client's needs.

C2

PRODUCTS	AESTHETICS	COST	CUSTOMER OR TARGET MARKET	ERGONOMICS	FUNCTION	MATERIALS
 Kitchen Safe https://www.thekitchensafe.com/	- Contrasts the Brown colour of the coffee and side tables - The white cover of the safe conforms with the other white items that my client has placed on her bedside table	\$66.14	- Adults battling addiction (smoking, etc) - Parents locking away food products or addictive gadgets like phones and gaming consoles	Small and compact which, making it easy to carry around	Sufficient space to store an iPhone X - Once the timer is set and the button is clicked to lock the box, it only opens once the timer reaches zero - After pressing the button, the lock activates after 5 seconds, giving the user a chance to double check the entered time	No element of wood to conform with furniture BPA free plastic is used to create the thick walls of the container - Relatively lightweight No sharp edges which reduce the risk of scratching the table's surface
 Time Locking Safe https://timelockingsafe.com/	- The dark grey colour will not complement the brown furniture - The dull colour of the box does will not make it easily visible amongst the other items it would be placed with	\$342.94	- Adults with expensive jewellery or accessories - Items placed inside are not visible from the outside of the box, making it ideal to place confidential documents	The steel body and door causes the product to be large and bulky, making it tough for Nety to carry around	- Sufficient space to store an iPhone X TIMER ON: A correct keypad code opens up the safe according to the timer settings TIMER OFF: The key can be used to open the safe (useful incase the user forgets the code)	- This product is made out of steel No element of wood to conform with furniture Heavyweight, may cause deep and intense dents on the bedside table

RESEARCH: COLLECTION OF RELEVANT DATA



DIMENSIONS AND WEIGHT

I used appropriate pieces of equipment (**measuring tape and mass balance**) to measure the **dimensions and weight** of Aryan’s phone.

This is critical data needed to make sure that my product can fit Aryan’s phone and be strong enough to carry its weight.

Length: 14 centimetres
Width: 7.2 centimetres
Weight: 174 grams
Depth: 7.7 millimetres

PHONE DIMENSIONS AND WEIGHT

LOCATION AND AESTHETIC

This is the bedside table that the phone box will be placed in. I measured the **dimensions** of the exact area available to keep the product. The product should fit the **designated area** and **compliment the colour of the wood**.

Length: 24 centimetres
Width: 45 centimetres

BEDSIDE TABLE DIMENSIONS



Dents and Scratches on the bedside table

ENVIRONMENT

My client’s bedside table has many **scratches and dents**. Since it is made out of **teakwood** (hardwood), it is difficult to remove these dents. In order to **avoid damage** to the table, my product must not have **sharp edges** (to reduce scratches) and should **be lightweight** (to avoid deep dents). If the product is lightweight, it also allows Nety to carry it around with ease when needed to place it somewhere other than on her bedside table (eg. when leaving the house).

- C1
- C2
- C3
- C4
- C5
- C6
- C7

EVALUATION

By analysing the **design environment** and the **item** that is going to be placed in my product, I can better understand my client’s **needs and wants**.

My clients wants a box that is sleek and does not take up a large amount of space on her table. However, this box also must have a sufficient amount of space required to fit Aryan’s phone.

HOW WILL THE COLLECTION OF THIS DATA INFLUENCE MY DESIGN?

In order to ensure that the box does not take up a lot of space on the bedside table, my client has informed me that the table should not cover more than **2 third’s of the given area**. This means that my product **must not exceed** these measurements:

Heigh: 16cm
Width: 30cm

From the data I have obtained, I can derive that I must design a product with **specific measurements** that fulfils both these **requirements**.

RESEARCH: INSPIRATION BOARD AND CLIENT INTERVIEW

The following page shows the inspiration board compiled of images related to my design problem as well as the aesthetic for my solution. It also includes a client interview where I was able to find out more about my client's needs and wants.

INSPIRATION BOARD



Contrasts the brown colour of the table ✓



Not aesthetically pleasing ✗



Big and Heavy ✗



Big and Heavy ✗



Element of Wood ✓



Not aesthetically pleasing ✗



Compact and Lightweight ✓



Element of Wood ✓



Contrasts the brown colour of the table ✓



Too Big ✗

CLIENT INTERVIEW

Question to Self: What do I hope to find out from this interview?

From this interview, I hope to **collect feedback** from my client on the current progress of the solution. The client will be able to see **possible ideas, existing products** and **circuits** from the past few pages. Questions will be asked to obtain **concrete feedback** to form the **design specifications** in the future. The questions will be based on **existing products, collection of data** and the **inspiration board**.



EXISTING PRODUCTS

What do you like or dislike about the existing products?
"I think that the kitchen safe is very **aesthetically pleasing** and I like the **transparent** body of it because it will contrast the brown colour of the bedside table. However, the **cost** of this product is **too high** for me. I do not like the aesthetic features of the time locking safe. The overall dull colour will not complement the **design environment**. The price is also **unreasonably high**."

COLLECTION OF DATA

Are there any specific design features I should consider?
"I think that you could consider making the product white coloured as this will accompany the other white items placed on the bedside table. I also think that you should consider making the phone box **sleek** and **compact** so that it does not occupy a **large area** of the table."

INSPIRATION BOARD

What do you like or dislike about the following solutions?
"I like the sleek and compact product designs because they will not occupy a large area of my table. I do not want **big** products such as the **top left** and **bottom right** and **heavy** products such as the **top right** and the **left centre** as they are **not** easy to carry around and may **dent** the table. I **dislike** the product with the **cage design** because it is **not aesthetically pleasing** and does **not fit** the **design environment**. I think that the **small elements** of **wood** in the product might allow it to **conform** with the **traditional** and **classic** style of the bedroom."

EVALUATION

Conducting the interview led to a recap of the **needs and wants** of my client. Based on my clients likes and dislikes on the **existing products**, I was able to better understand my client's **preferences** which will help me create an appropriate solution. I learnt that Nety wants a **compact** and **lightweight** product that **complements** the **wooden bedside table** it will be placed on.

RESEARCH: DESIGN SPECIFICATIONS

The following page shows the design specifications I have obtained from my research so far. By considering these specifications, I can create a design solution that fulfils all my clients requirements.

C2

FACTORS	REQUIREMENTS	JUSTIFICATIONS	METHOD OF TESTING
1 AESTHETICS	1.1 - The product must have a clear or white coloured element.	1.1 - Based on my clients preferences, she feels that a white coloured product will complement the bedside table.	1.1 - Do a visual check in and ask for feedback from client.
2 COST	2.1 - The product must not cost more than \$40.	2.1 - My client wants a reasonable pricing in order to spend money on the product appropriately.	2.1 - Provide a receipt for the client and check for approval.
3 ENVIRONMENT	3.1 - Product must be lightweight. 3.2 - The products should not have sharp edges.	3.1 - This will reduce the risk of deep dents caused by heavyweight items. 3.2 - Reduces scratches on the surface of the wood.	3.1 - Do a check with client.
4 SIZE	4.1 - Product must fit on the bedside table (Length: 24cm, Width: 45cm) and not take up more than 2/3 of the space. 4.2 - Must fit the iPhone X inside (Length: 140mm, Width: 72cm, Depth: 77mm).	4.1 - The product must fit on the table in order to be situated there. The space on the table is limited , therefore my client wants the product to only take up a small area. 4.2 - In order to store Aryan's phone in the box without causing any it any damage , it is important to design the product with appropriate dimensions.	4.1 - Measure the product and check if it takes up more than 200mm of the table's length and 400mm of the width. 4.2 - Test in front of client whether Aryan's phone can fit comfortably.
5 FUNCTION	5.1 - Product must have a timer switch with LED's that display the timer countdown. 5.2 - Must include a lock or solenoid which opens and closes the box.	5.1 - Nety wants Aryan's phone to be locked for the time periods in which he studies. 5.2 - My client needs the phone to be securely locked so that her son cannot steal his phone back from her.	5.1 - Test the circuit to ensure that it can perform all functions my client has specified.
6 MATERIALS	6.1 - Product should include an element of wood.	6.1 - My client wants the product to conform with the overall incorporation of wooden furniture in the bedroom.	6.1 - Visual test , check with client that the materials meet their requirements.

EXPLORATION OF DESIGN IDEAS

The following pages show detailed annotations on 6 designs alongside evaluations of each one against the design specifications. This will allow me to pick the most suitable design to further develop and manufacture for my client.

C1
C2
C3
C4
C5
C6
C7

DESIGN IDEA 1

The phone will be placed **vertically** in the compartment, and the **PTM switches** can be used to **adjust** the time the box is locked for.

Phone Compartment

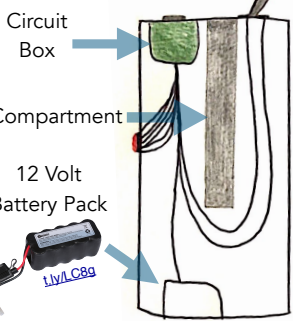
This will be the **compartment** where the phone will be slotted in.

A **hinge** will be placed in the top left corner of the compartment for it to be opened and closed.

Width: 31.75 mm
Length: 38.1 mm

(3D Printed, Acrylic)

Circuit Placement



Joining Methods



EVALUATION

- Aesthetics
- Ergonomics
- Safety
- Function
- Materials

EXPLANATION - What works? What doesn't?

The box is **user-friendly** and can be **easily operated**. The base of this design matches my client's wants of having an element of wood, however due to it's short height, it may **not** be very visible. The white acrylic body **contrasts** the **brown** colour of the design environment (bedside table). However, due to the **shape** of this design, when the phone is placed inside the **compartment**, the product may **topple** over easily. This relates back to Nety's concerns of having a product that will not damage the bedside table with **dents** and **scratches**. This may also cause **damage** to the phone placed inside.

Toggle Switch

This **toggle switch** will be used to turn on and turn off the **circuit**.
Diameter: 12.7 mm

LCD Screen

This will display the **time** entered by my client.

Engraving

This label will be made by **engraving** letters into the acrylic body using a laser cutting machine.
Length: 70 mm
Width: 35 mm

Teak Wood

This wood element meets my client's want of having a product that reforms with the **design environment** of her bedroom that primarily contains **teak** furniture.

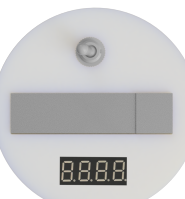
Solenoid Lock

This **solenoid lock** will be placed opposite the hinge in the compartment. It will be used to **lock** and **unlock** the box.
Length: 5 mm
Width: 15 mm

PTM Switches

These three switches will be used to **adjust** the time in terms of hours, minutes, and seconds that the box will be locked for.
Diameter: 16 mm

Top View



Front View



DESIGN IDEA 2

The lid on the box can be **opened** to **place** the **phone** in the **compartment**. Using the **PTM switches**, the time can be **set** for the box to be **locked**. Once the time is up, it will **re-open**.

Phone Compartment

This 3D printed **acrylic** compartment will be used to store the phone.

A **hinge** will be placed in the compartment for it to be opened and closed.

Width: 31.75 mm
Length: 38.1 mm

PTM Switches

Red: To turn on and turn off the circuit.
Green: To adjust the hours, minutes and seconds that the box will be locked for.
Diameter: 16 mm

Red Oak Wood

This will fulfil my client's **want** of having a wood element in the design.

Joining Methods

The user interface and body can be joint by **epoxy resin**.

The 5 pieces of wood will be joint by a **diagonal butt joint**.

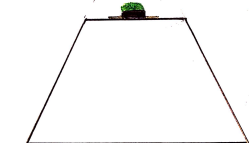
LCD Screen

This will display the **time** entered by my client

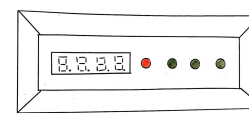
Solenoid Lock

The **solenoid** will allow the box to be locked and unlocked for the **desired** time.

Top View



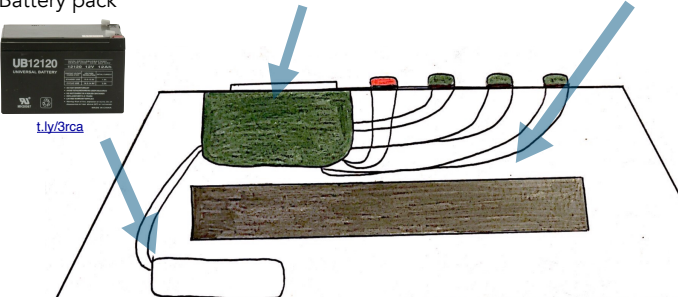
Top View



Acrylic

The **user interface** is made out of acrylic and will be **laser cut**. The white colour will **contrast** the wooden furniture in my client's bedroom.

12 Volt Battery pack



EVALUATION

- Aesthetics
- Ergonomics
- Safety
- Function
- Materials

EXPLANATION - What works? What doesn't?

This design has many **sharp edges** which could cause dents in the bedside table. These sharp edges could also be **dangerous** and **harm** my client. The **red oak wood** will reform with the **traditional** and **classic** style of Nety's bedroom, and the **user interface** and compartment made out of **white acrylic** will provide **contrast** in the design environment. This product is **easy to use** and meets all the requirements for the phone to be **securely** locked, and for the box to re-open. However, the **shape** of the box leaves out a lot of **excess** wood, which will only take up more of the **limited space** that my client has on her bedside table.

EXPLORATION OF DESIGN IDEAS

DESIGN IDEA 3

The box is divided into **two** sections. One containing the circuit, and the other being a compartment for the phone to be placed in. The **red PTM** switch turns the circuit on, causing the **LED to light up**. The **green PTM** switches will be used for inputting a time that the solenoid lock will **lock** the compartment for.

LCD Screen



Displays the amount of **time** set for the box to be locked.

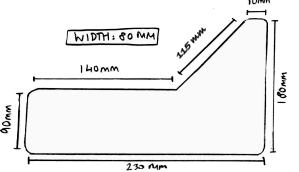
Teak Wood



The use of **teak wood** will make sure that my product reforms with the **design environment**.

Side View

This is the **side view** of My product with the accurate **dimensions** labelled.



Acrylic



PTM Switches

These switches will be used to **adjust** the period of time that the box will be **locked** for. Diameter: 16 mm



LED

When the **circuit** is turned on, the LED will **light up**. Diameter: 5 mm

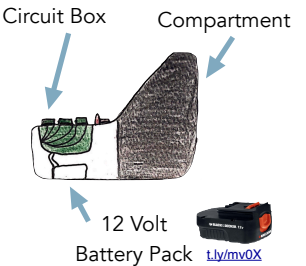


RED PTM Switch

This **red PTM switch** will be used to turn on and turn off the circuit. Diameter: 11 mm



Circuit Placement

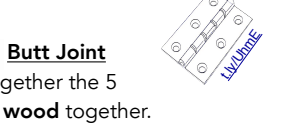


Engraving

This text will be **engraved** using a **CNC machine**.

Joining Methods

Hinge
A hinge will be attached to connect the compartment with its lid, allowing it to be **opened and closed**. Length: 46 mm Width: 38 mm



Filleted Edges

The edges of the box will be **filleted** using a **sanding block** and **CNC machine**. This will prevent the product from **scratching** the bedside table.



Solenoid Lock

This **solenoid** will be used to **lock and unlock** the **compartment**. It will be slotted behind the **overhanging** part of the lid. When the time is up, the solenoid will change positions. Length: 4 mm Width: 9 mm



EVALUATION

- Aesthetics
- Ergonomics
- Safety
- Function
- Materials

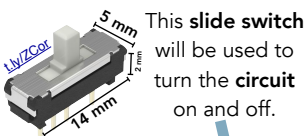
EXPLANATION - What works? What doesn't?

In this design, the **division** between the two compartments makes it easy for my client to use. Since the **controls** and phone compartment **lid** are on the same face, using both simultaneously will be simply and easy. The filleted edges eliminate the risk that **sharp edges** bring, making the product **user friendly** and safe to be placed on the table. The element of wood is present and the white acrylic user interface will **complement** the brown colour of the area. The engraved text brings a **polished** look to the design in terms of **aesthetics**.

DESIGN IDEA 4

The **wooden lid** of this box can be opened to place the phone inside. The time set to lock the box through the **switches** will be displayed on the **LCD screen**.

Slide Switch



This **slide switch** will be used to turn the **circuit** on and off.

PTM Switches

These switches will be used to **adjust** the duration that the box will be locked for. Diameter: 16 mm



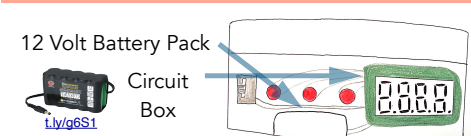
Joining Methods



Hinge
A hinge will be attached in order for the box to **open and close**. Length: 46 mm Width: 38 mm



Circuit Placement



LCD Screen



Displays the **time** entered by switches.

Solenoid Lock

This will ensure that the phone is **securely** locked. It will be placed opposite the hinge. Length: 4 mm Width: 9 mm



Engraving

These letters will be engraved onto the wood by a **CNC machine**. Length: 74 mm Width: 40 mm



Mahogany Wood

This is the element of **wood** in my design as my client wanted.

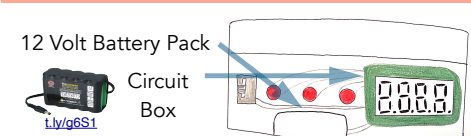


Acrylic

This will be **3D printed**.



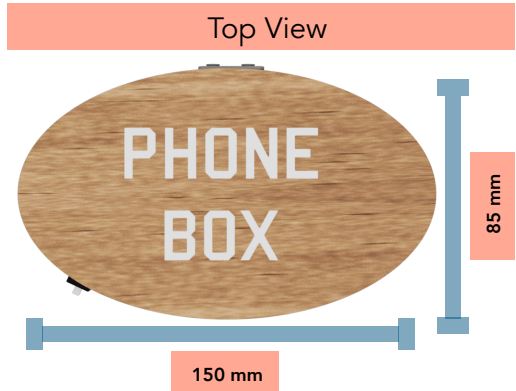
Phone Compartment



Top View



Top View



EVALUATION

- Aesthetics
- Ergonomics
- Safety
- Function
- Materials

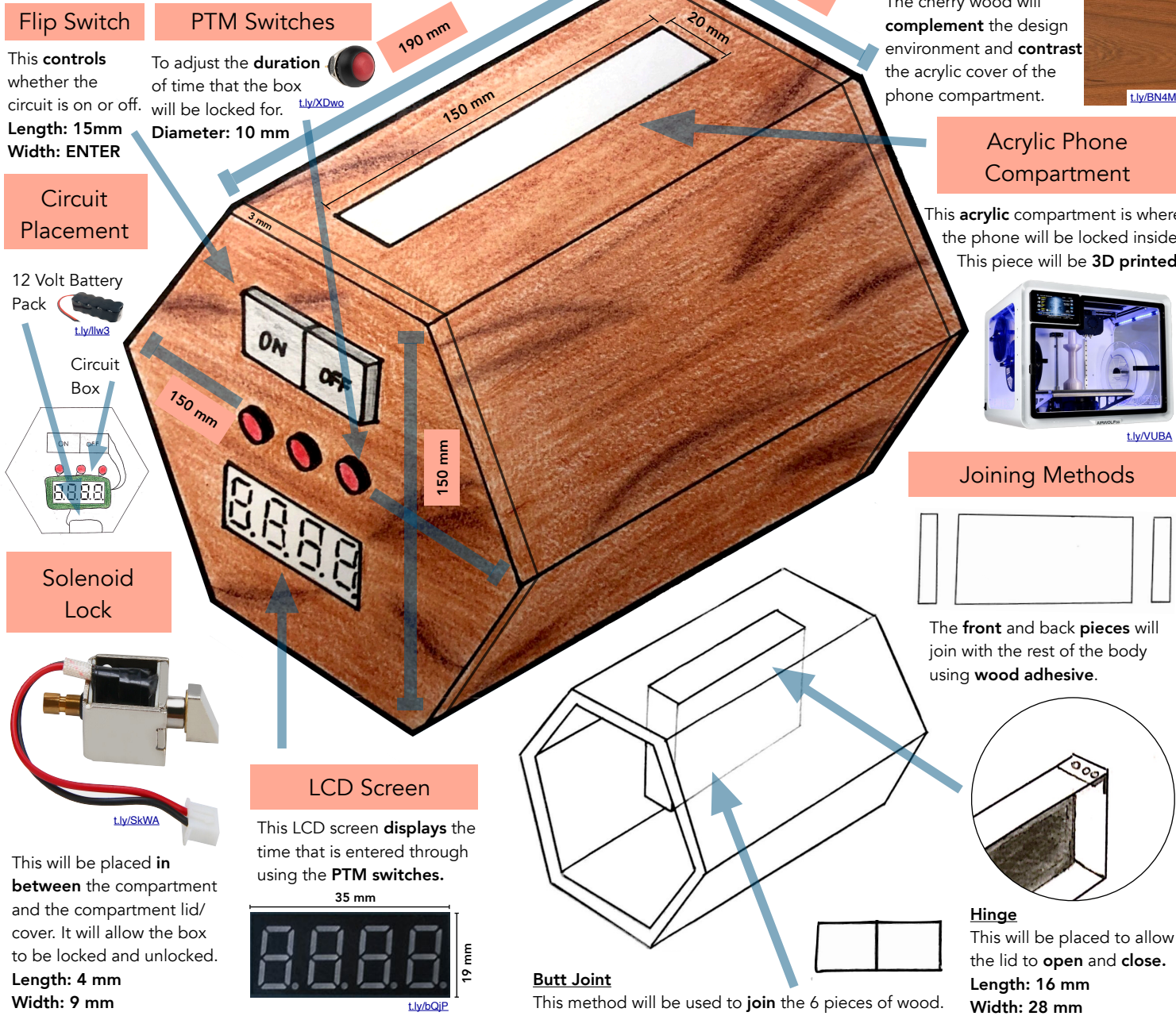
EXPLANATION - What works? What doesn't?

The **elliptic cylinder shape** of this design is slightly **eccentric** which makes its **aesthetic** features quite unique. The box's close placement of all the switches makes it **user friendly**. The product is also relatively small in comparison to the other designs, making it **compact, lightweight** and easy for my client to bring around. However, the shape of this design occupies **excess space** on the sides, which will limit the area left behind on the side-table after the product is placed on it. The design meets all the **requirements** in terms of materials.

EXPLORATION OF DESIGN IDEAS

DESIGN IDEA 5

The compartment where the phone will sit in is placed at the **very top** of the box. The **PTM switches** can be used to **adjust** the time and **lock** the box.

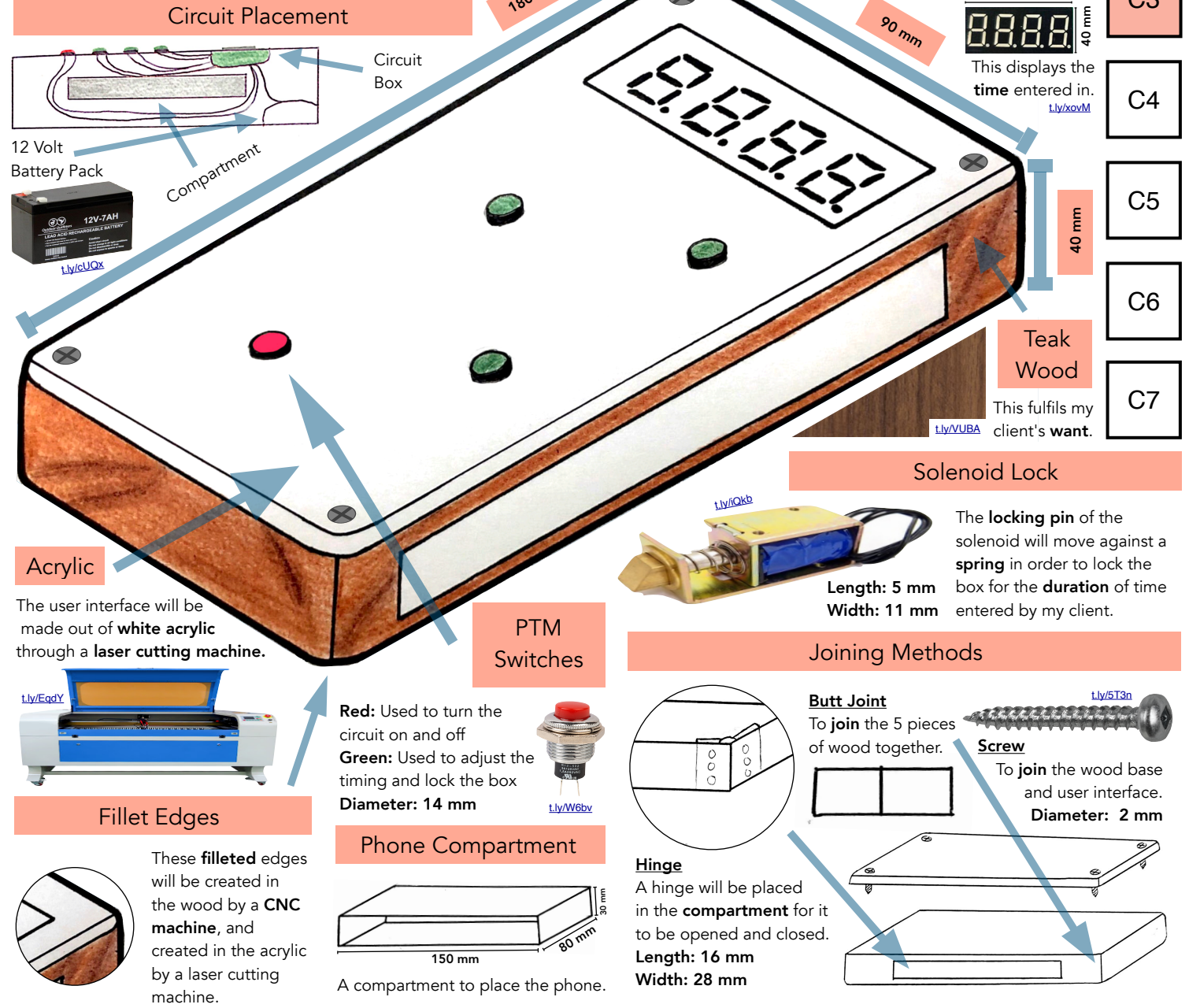


EVALUATION	
	Aesthetics
	Ergonomics
	Safety
	Function
	Materials

EXPLANATION - What works? What doesn't?	
The aesthetic features of this design are quite poor . The shape is unique , however the unnecessary size of the product is ineffective and will take up the limited space on the bedside table, making it less practical. This design includes both elements of wood and white acrylic , however the use of acrylic is quite minimal and only visible in the compartment lid. This might lead to the product blending in with the table and not having any features that stand out. There are also several sharp edges which makes it dangerous to use and increases the chances of dents and scratches .	

DESIGN IDEA 6

The phone will be stored in the compartment. The **duration** of the time can be **adjusted** by the **green PTM switches** and seen on the **display**.



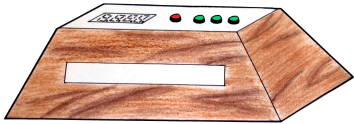
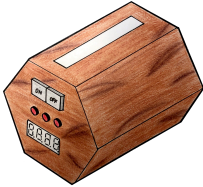
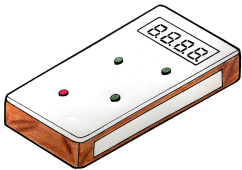
EVALUATION	
	Aesthetics
	Ergonomics
	Safety
	Function
	Materials

EXPLANATION - What works? What doesn't?	
This design is supposed to replicate the structure and appearance of a phone. This concept is captivating , however the design is instead too simplistic . The filleted edges ensure that there will be a low risk of dents and scratches . The user interface is easy to operate with and the LCD display is large enough to be clearly visible even from a slight distance. Wood and Acrylic are both present in this design which will allow it to reform with the design environment .	

CLIENT AND SELF REVIEW

The following page shows the evaluation of all 6 design ideas by my client and I. It will address the features of each design that are positive and negative. There will also be a score for each design, from which the highest scoring design will be further developed.

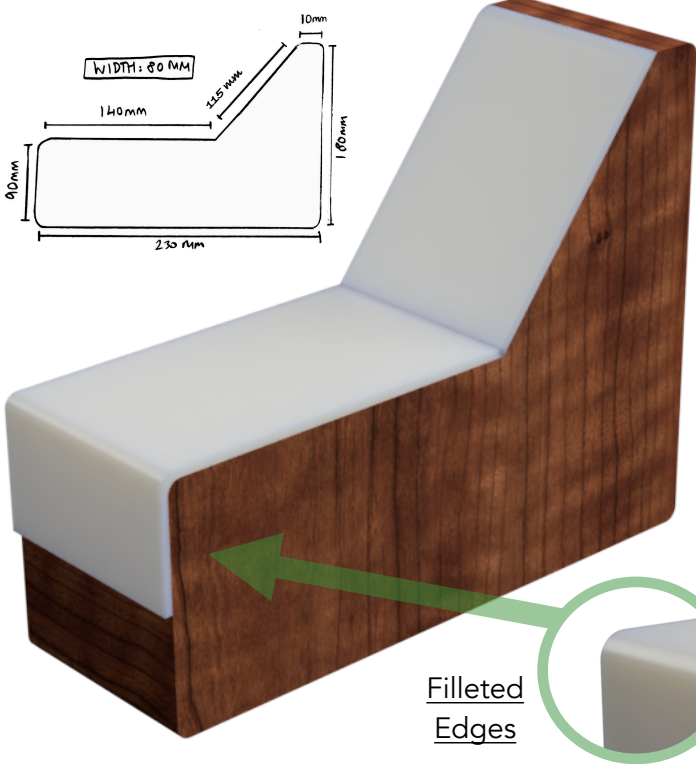
C3

6 DESIGN IDEAS	CLIENT EVALUATION 0=Not Met Expectations, 1=Partially Met Expectations, 2=Met Expectations	SELF EVALUATION	SCORES
DESIGN IDEA 1 	Aesthetics - "The white colour contrasts the brown colour of the bedside table." Ergonomics - "The product is relatively lightweight." Safety - "The product will easily topple over and could damage the phone inside." Function - "It includes all the necessary components." Materials - "The container is white, however the element of wood is not very visible." SCORE: 2 SCORE: 2 SCORE: 0 SCORE: 2 SCORE: 1	I think that this design is quite aesthetically pleasing which the features of the delicate wood base and the engraved text, however I believe that the element of wood is not sufficient enough for my client. Additionally a major issue is that the box is likely to topple over when the phone will be placed inside.	7/10
DESIGN IDEA 2 	Aesthetics - "The product have some pleasant aesthetic features." Ergonomics - "The product is relatively lightweight." Safety - "The product has many sharp edges!" Function - "It includes all the necessary components." Materials - "The user interface and lid is white, and there is an element of wood." SCORE: 1 SCORE: 2 SCORE: 0 SCORE: 2 SCORE: 2	This design has some pleasant aesthetic features since the shape of the product is quite eccentric. However, this design also has many sharp edges and could therefore dent and scratch the bedside table it will be placed on (design environment).	7/10
DESIGN IDEA 3 	Aesthetics - "The product reforms with the traditional and classic style of the area." Ergonomics - "The product is relatively lightweight." Safety - "This product does not have any sharp edges." Function - "It includes all the necessary components." Materials - "The user interface and text is white, and there is an element of wood." SCORE: 2 SCORE: 2 SCORE: 2 SCORE: 2 SCORE: 2	I think that this is the most ideal design. The added component of an LED adds to the aesthetic aspect and also helps make the product more user friendly as it will indicate when the circuit is turned on. I also believe that the engraved text adds to a further polished look.	10/10
DESIGN IDEA 4 	Aesthetics - "The product must matches the design environment." Ergonomics - "The product will occupy excess space on the bedside table." Safety - "This product does not have any sharp edges." Function - "It includes all the necessary components." Materials - "The acrylic will contrast the table and the wood will reform with the style." SCORE: 2 SCORE: 1 SCORE: 2 SCORE: 2 SCORE: 2	In this design, the product is very compact, therefore lightweight. The added hinge also makes it easy to use. However, the shape of this design is such that will occupy excess space in the design environment.	9/10
DESIGN IDEA 5 	Aesthetics - "There are not distinct features that contrast the style." Ergonomics - "The product will occupy excess space on the bedside table." Safety - "The product has many sharp edges!" Function - "It includes all the necessary components." Materials - "There is an element of wood, however there are no contrasting features." SCORE: 1 SCORE: 1 SCORE: 0 SCORE: 2 SCORE: 1	I believe that the shape of this design is not ideal at all. The product is unreasonably large and the element of acrylic is not very visible. This design also has many sharp edges, making it dangerous and increasing the chances of causing dents and scratches.	5/10
DESIGN IDEA 6 	Aesthetics - "The product is too simplistic." Ergonomics - "The product is relatively lightweight." Safety - "Due to the filleted edges, this product won't dent or scratch." Function - "It includes all the necessary components." Materials - "The white user interface and lid will contrast the brown bedside table." SCORE: 1 SCORE: 2 SCORE: 2 SCORE: 2 SCORE: 2	This design meets the requirements of having acrylic and wood, allowing it to complement the design environment. Since this design is made to look like a phone, I believe that the concept is quite interesting however I also think that it is too simplistic.	9/10

DEVELOPMENT OF SHAPE AND FORM

The following page shows the decisions made regarding the shape and form of the product. There will be four developments made upon addressing the modifications and areas of improvement, leading to the final design.

C1
C2
C3
C4
C5
C6
C7



DEVELOPMENT 1

What will my client like?

- **Fillet Edges** reduces risk of dents and scratches. It is also aesthetically pleasing.
- **Simultaneous operation** of user interface and box compartment since they are closely located.

Areas for Improvement?

- **Shape** of box is too irregular. My client would prefer a different shape.
- **Unstable** since there is a great height difference between phone and circuit compartments.



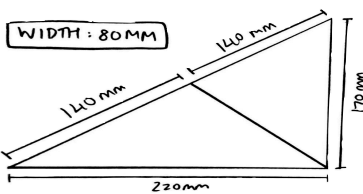
DEVELOPMENT 2

Modifications Made

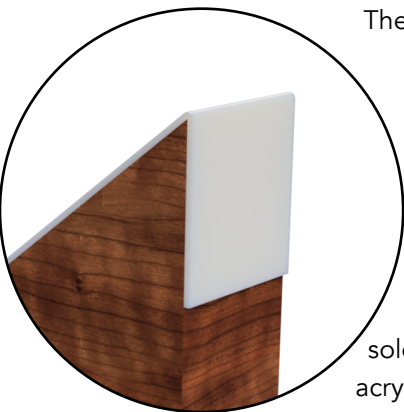
- **Shape** is more regular, equally angled edges.

Areas for Improvement?

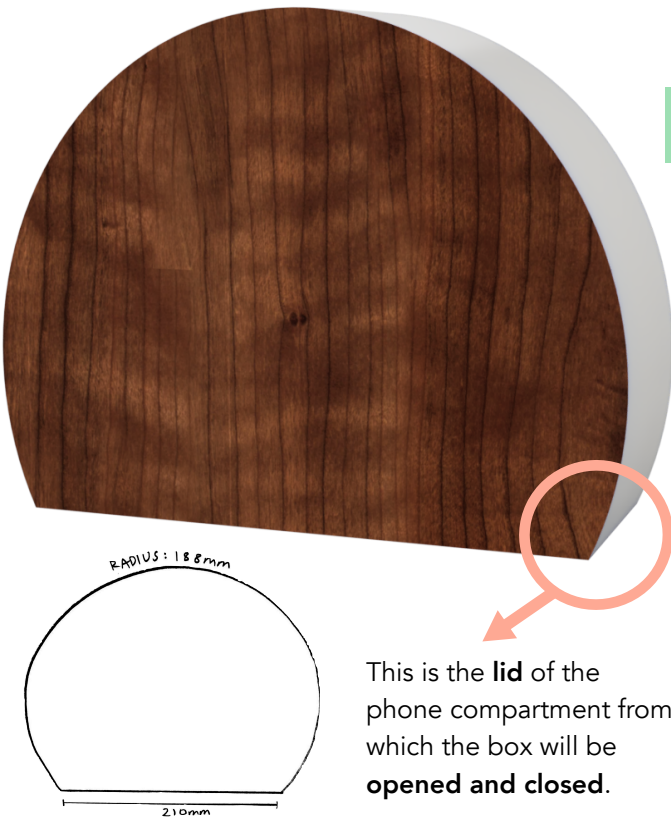
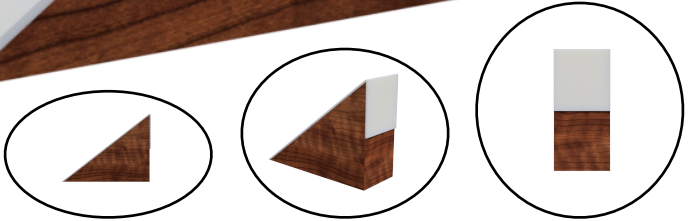
- **Sharp Edges** can cause dents and scratches on bedside table.
- **Triangular Shape** is not particularly preferred by my client.



Lid Flap



The lid will be used to **open** and **close** the phone compartment. Upon being locked, the **solenoid** lock will move in place to **lock** into the acrylic lid piece. When unlocked, the solenoid will move out of the acrylic, **opening** the box again.



DEVELOPMENT 3

Modifications Made

- **Shape** is rounded and less triangular.

Areas for Improvement?

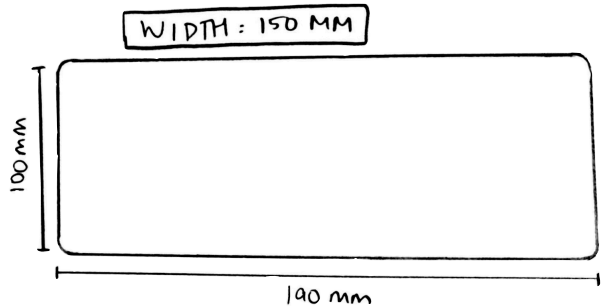
- **Making** the design will be difficult due to the curved nature.
- **Unstable** since product is tall and thin. This will make it more likely to topple.
- **Difficult to open** lid of box.



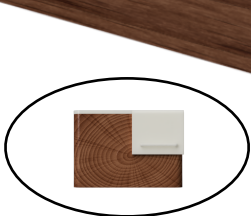
DEVELOPMENT 4

Modifications Made

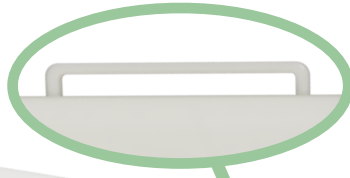
- **Handle** will allow the box to be opened and closed more easily and contribute to the overall ergonomics.
- **Text Engraving** brings a polished look.



Text Engraving



Attached Handle

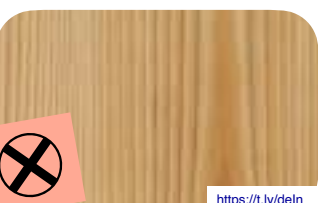


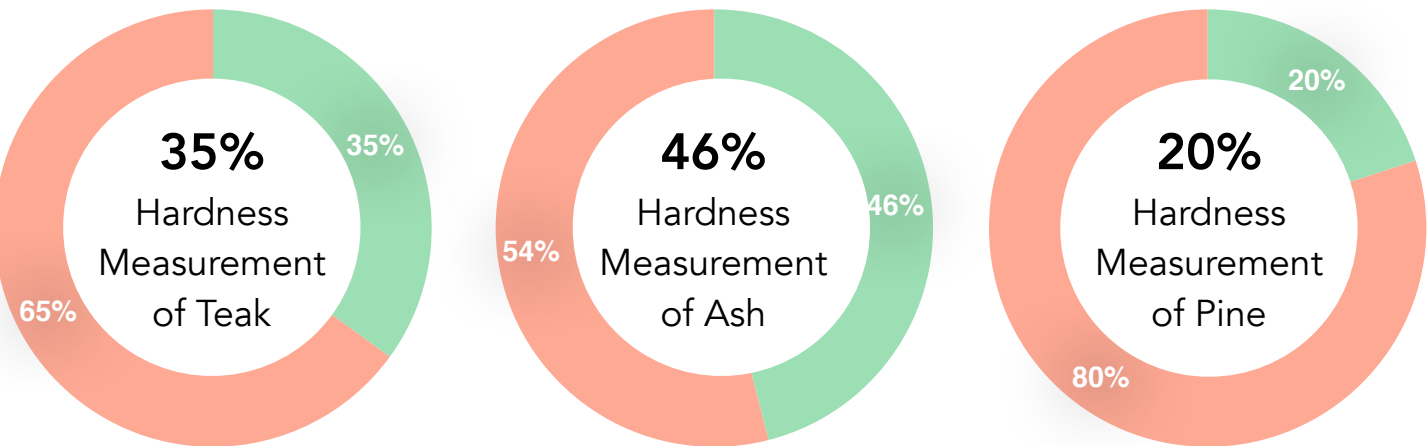
Fillet Edges



DEVELOPMENT OF MATERIALS AND FINISHING

HOUSING - MATERIALS

TEAK	ADVANTAGES	DISADVANTAGES
	- Aesthetic (straight grain pattern) - Strong and Durable - Low Maintenance (does not require too much finish)	- Can blunt tools - Scarce and Expensive - Difficult to glue together
ASH	ADVANTAGES	DISADVANTAGES
	- Elastic and Flexible - Resists Wear - Hard and Tough - Lightweight - Stable - Finishes Well	- Not suitable in all weathers (humidity may cause stains) - Brittle structure - Delicate Grain - High risk of splintering and poor stability (due to low density) - Low durability
PINE	ADVANTAGES	DISADVANTAGES
	- Relatively Cheap - Strong and Durable - Malleable (softwood) - Resistance against rotting and decaying - Aesthetic grain pattern - Easy to stain (change colour)	- Change colour over time - Easy to wear and tear - Easy to scratch and dent - Prone to warping - Tendency to twist and knot - Lacks toughness



Decision Made

My final decision is to use **teak wood** for my housing. The aesthetics of the wood is **most suitable** for my product as it is pleasing and will **conform** with the **design environment**. The **properties** of the wood will allow for a **strong** housing that can **bear the** phone's **weight** and still stay relatively **lightweight**. Teak wood will also ensure that with time, the product **remains** in good condition.

The following page shows the decisions made regarding the materials and finishes needed. The options selected are indicated by a green tick, and the others are marked with a red cross.

HOUSING - FINISHES

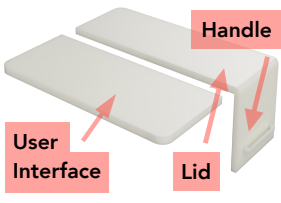
TEAK OIL	LACQUER	VARNISH
		
ADVANTAGES	ADVANTAGES	ADVANTAGES
- Protects against UV rays - Resistance against water	- Minimal Colour Change - Dries quickly	- Natural Rustic Appeal - Easy to apply
DISADVANTAGES	DISADVANTAGES	DISADVANTAGES
- Slight colour change - Makes difficult to glue	- Scratches easily - Bubbles formed easily	- Dull over time - Can damage in sunlight

Decision Made

I will proceed with the **teak oil finish** since it is designed for **dense** woods such as teak, which is the material being used for my housing. Due to its **resistive** properties against **moisture**, Teak oil will also act well under the **humid weather conditions** of **Singapore**, keeping the housing in good condition.

USER INTERFACE, LID, AND HANDLE - MATERIALS

TIMBER		TEAK
		
ADVANTAGES	ADVANTAGES	ADVANTAGES
- Anti-Corrosive - Lightweight	- Strong and Stiff - Lightweight	- Moisture Resistant - High Durability
DISADVANTAGES	DISADVANTAGES	DISADVANTAGES
- Rots over time - Discolours over time	- Expensive - Scratches easily	- Difficult to glue - Can blunts tools



Decision Made

I will proceed with a white **acrylic** user interface, lid, and handle as it will **contrast** the teak wood. It will also **complement** the **brown colour** of the bedside table.

DEVELOPMENT OF JOINING AND CONSTRUCTION METHODS

The following page shows decisions made regarding the joining and construction methods. A green tick indicates a selection.

HOUSING



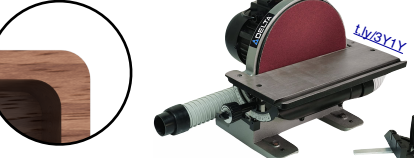
☒ Option 1 - CNC Milling Machine

The CNC Machine can be used for to shape my wood with **high precision** and **efficiency**. This option will allow me to obtain a very accurate wood housing.

☐ Option 2 - Handmade



In order to hand-make the wood housing, I can utilise **finger joints**. In order to create these joints, I can use a **coping saw**.



After joining the six sides of the box, I can use a disc sander to obtain the filleted edges.



Decision Made

I will be using the **CNC milling machine** to create my wood housing as it will be the more **efficient** than the hand-making process. It will also ensure a more **accurate final product**.

JOINING HOUSING AND USER INTERFACE



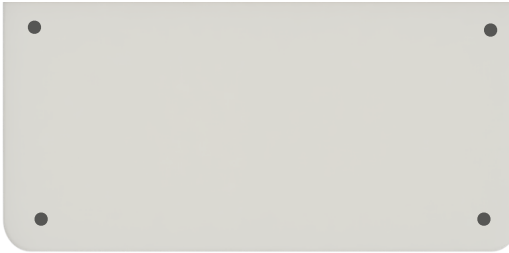
☒ Option 1 - Epoxy Resin

Epoxy resin will allow me to **strongly glue** together the two parts of my product. The resin also has high **durability**, and **resistance against chemicals**. It also hardens quickly.



☐ Option 2 - Wood Screws

Wood Screws will allow me to **securely clamp** the housing and user interface together. By using screws, I will also have the ability to **access** the **circuit compartment** if needed in the future.



Placement of Screws



Decision Made

I will use epoxy resin to join together my housing and user interface since it will be **substantially stronger**. This will reduce the risks of cracks and damage. It will also be a more **quick** process as opposed to screwing which will **save me time**.



JOINING BETWEEN HOUSING AND LID

☐ Option 1 - Ball Bearing Hinge



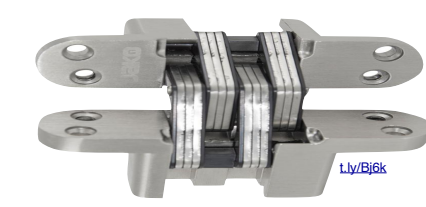
These hinges are heavy duty and highly **durable**.

☒ Option 2 - Butt Hinge



These hinges are highly **secure** for locked boxes.

☐ Option 3 - Concealed Hinge



These hinges area self-closing and **easily removed**.

Decision Made

I will be using the butt hinge as it is a **secure** lock, therefore the most **suitable** for my product. It is also the most **lightweight** hinge compared to the other options which will **add weight**.

JOINING BETWEEN LID AND HANDLE

☒ Option 1 - Epoxy Resin

Epoxy Resin is a glue that hardens very quickly and creates a strong and firm joint.

☐ Option 2 - Thread Screws

Thread Screws can be used to gain **mechanical advantage**. However they may **loosen over time**.

Decision Made

I decided to use the epoxy resin since it will be the more **stronger** joint. The glue will also keep the product **lightweight** as opposed to thread screws.

TEXT ENGRAVING ON WOOD

Option 1 - Laser Cutter



The laser cutter can be used to create a **precise** and **accurate** engraving.

Option 2 - Chip Carving

A chip carving knife can be used to **manually** carve letters and patterns onto different materials.



Font and Colour

The font will be **TREBUCHET MS**, and the colour chosen is white.



Decision Made

I will use the CNC milling machine as it is more **accurate** and **efficient**.

DEVELOPMENT OF USER INTERFACE

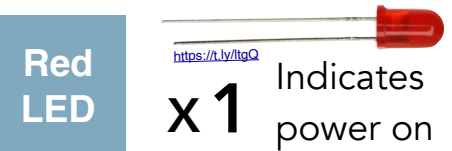
The following page shows the decisions made regarding the user interface of the product. Decisions will be made based on positive and negative characteristics. A green tick indicates that the option has been selected.

USER INTERFACE COMPONENTS

Green PTM Switches



x 3



x 1

7-Segment Display



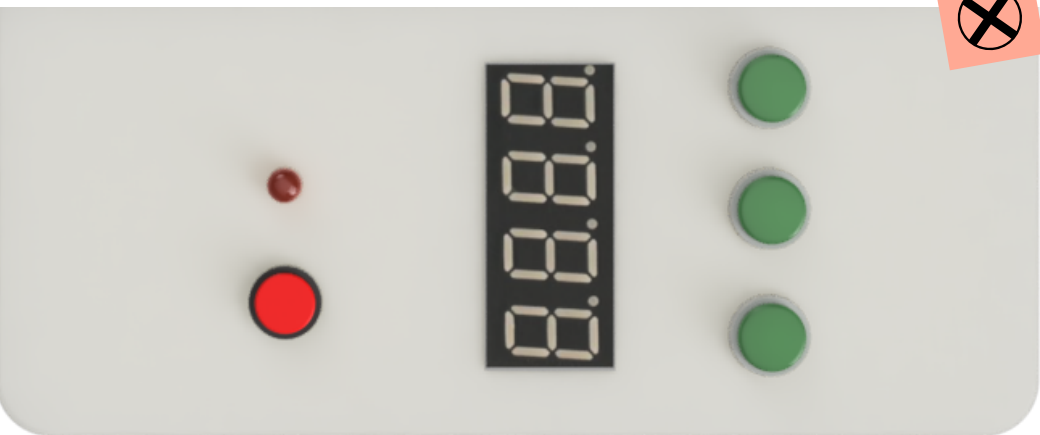
x 1

Red Push Button Switch



x 1

USER INTERFACE - OPTION 1



POSITIVES

Can be **easily used** while opening compartment lid.

NEGATIVES

Orientation of components is **misaligned** with front of box and text engraving.

USER INTERFACE - OPTION 2

POSITIVES

Orientation of components is **aligned** with front of box and text engraving.

NEGATIVES

Design of User Interface may be **too simplistic**.



Decision Made

I will be proceeding with the second user interface option since it is more **simple** and **user-friendly** compared to the first option. Additionally, since the components orientation **matches** the **orientation** of the engraving, the second option will also bring a more **aesthetically pleasing** and **polished** look.

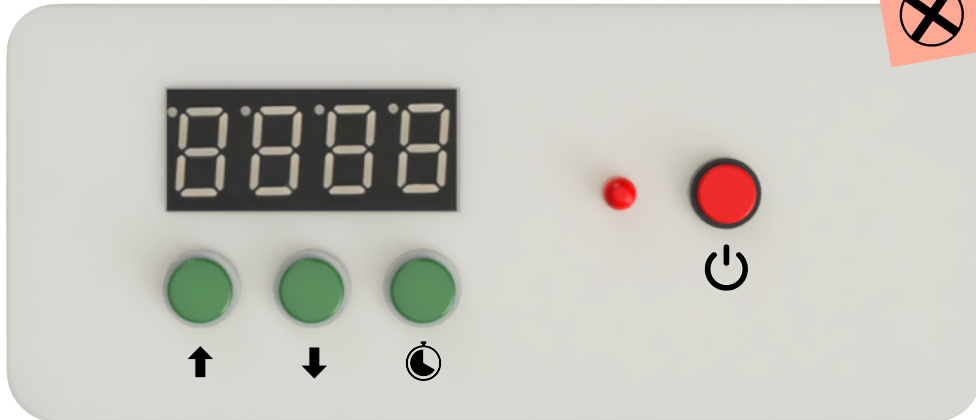
DESIGN - OPTION 1

POSITIVES

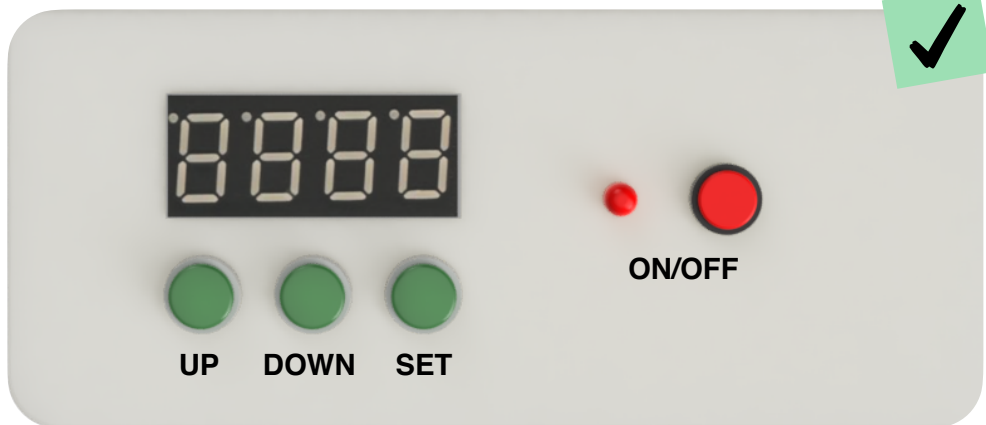
Small icons contribute to a **simplistic** design and **minimalistic** look.

NEGATIVES

Icons are **not** very aesthetically pleasing.



DESIGN - OPTION 2



POSITIVES

Overall **aesthetically pleasing**. Text allows for user interface to be **user-friendly**.

NEGATIVES

At first sight, it may appear as **difficult** to use and **operate**.

Decision Made

I will be using the second design option as it will be the most **user-friendly** for my client. The second design option is also more **aesthetically pleasing** and will greatly **enhance** the look of the product.

TEXT FONTS

ARIAL ROUNDED MT BOLD

PHOSPHATE

OPTIMA

TIMES

AVENIR

PINGFANG SC

APPLE CHANCERY

AMERICAN TYPEWRITER

RESEARCH: CIRCUIT SELECTION

The following page shows comparisons between two circuits, and between the various circuit components. Decisions have been made on the basis positive and negative characteristics. A green tick indicates that the option has been selected.

C4

CIRCUIT 1 - Digital Multifunction Timer Switch

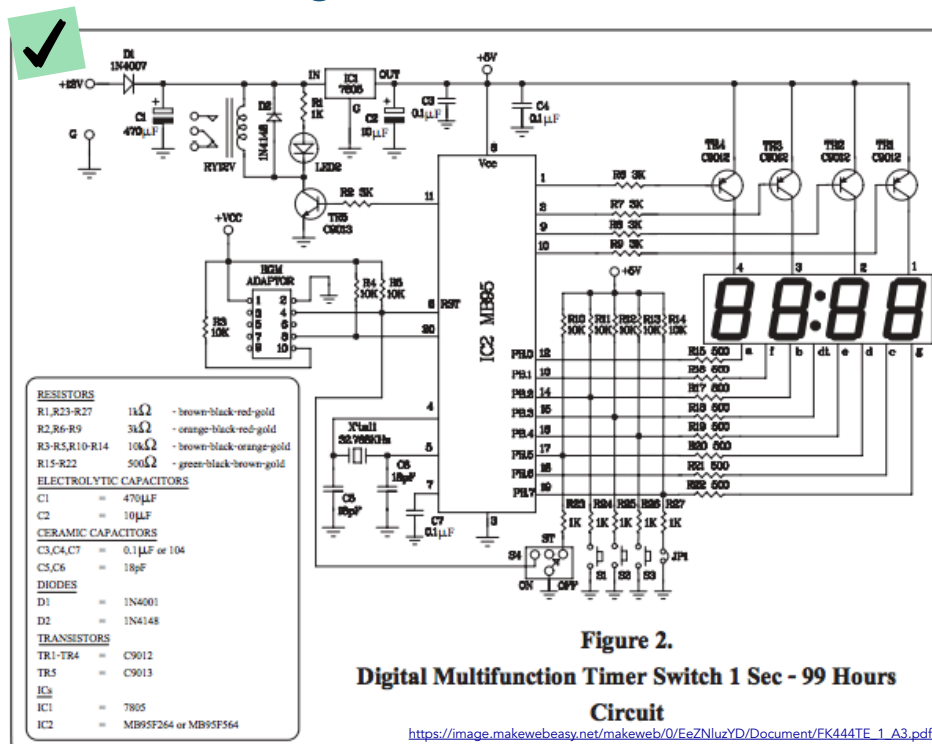


Figure 2.
Digital Multifunction Timer Switch 1 Sec - 99 Hours
Circuit

FUNCTION

After entering a specific amount of time, a timer will be set to lock the box. The box will open once the time passes.

INPUT

Switches - entering an amount of time and then setting the switch to ON will set the timer

COMPONENTS

- Resistor
- Electrolytic Capacitor
- Ceramic Capacitor
- IDE Pin - JP1
- Transistor
- Tact SW
- LED
- Diode
- IC 7805
- (Integrated Circuit)

PROCESS

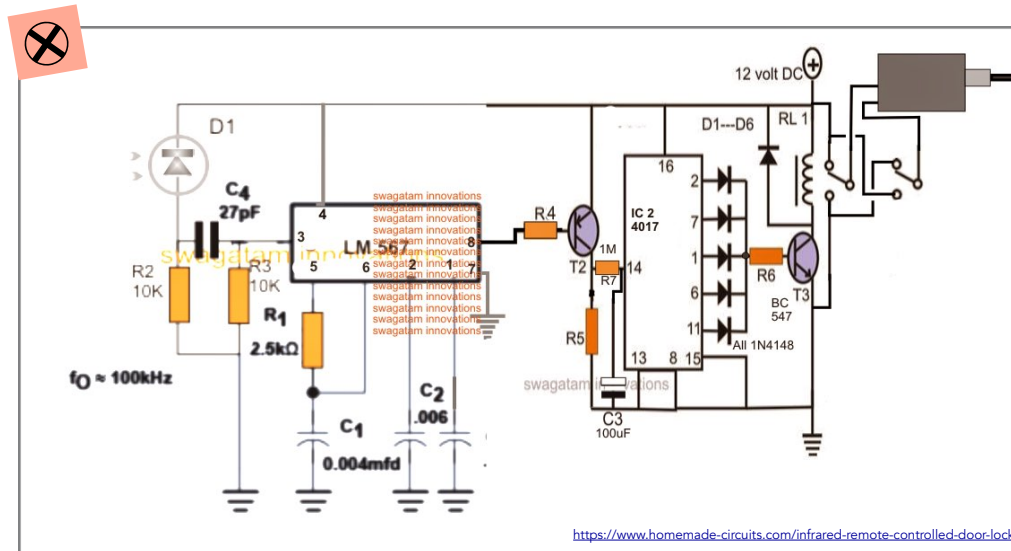
Micro controller -
programmed to schedule
when the box will open
based on the timer

OUTPUT

Solenoid/Electronic Switch

- I can attach any electronic switch based on my client's preference. This will lock the box until the timer finishes.

CIRCUIT 2 - Wireless Remote Control Relay



FUNCTION

The lock placed on the box is controlled by a wireless remote.

INPUT

Photodiode Sensor - turns the IR frequency from the IR transmitter into voltage

PROCESS 1

LM567 - activates the lock to be opened based on the detection of the remote command

PROCESS 2

IC 4017 - Receives the clock pulses, increments the counts and then activates the corresponding output

COMPONENTS

Photodiode Sensor
IR Transmitter
IC LM567
IC 4017

OUTPUT

Solenoid - linear motion causes the locking pin to move against a spring, arriving at an unlocked state

CIRCUIT 1

- Suits function of product
- Relatively easy to operate
- Switches may be difficult to use (up, down, set)

CIRCUIT 2

- Box is secure (can only be controlled by remote)
- Doesn't suit function of product (needs remote)

Decision Made

I will be using the first circuit as it best suits the **function** of my product and will **not** require an additional remote to operate.

CIRCUIT COMPONENTS

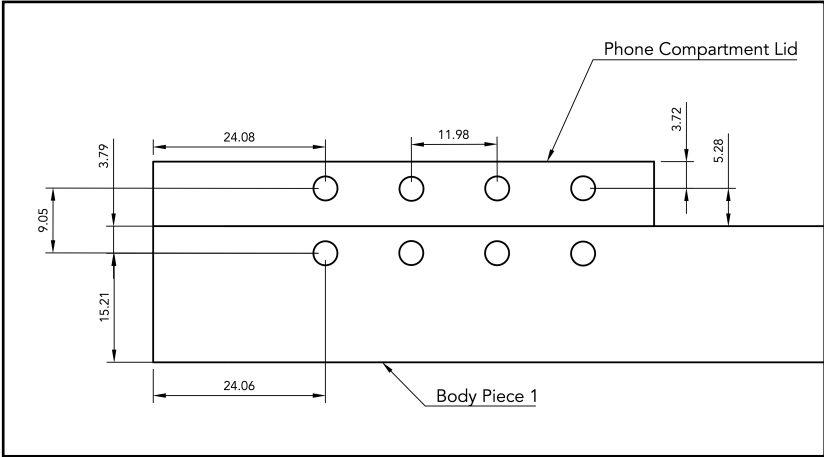
OPTION 1		OPTION 2		DECISION
LED				Considering red is commonly used to indicate power, I will use the red LED. It will also complement the white acrylic.
✓  Red PTM	✗  Green PTM			
POWER SWITCH				Since the circuit is time-locked, the rocker switch may not suit the product. The push button can be used a few ways to operate the circuit.
✓  Rocker Switch	✗  Push Button Switch			
PTM SWITCHES				Due to the red LED being used, I will proceed with green PTM switches - making the two circuit components easily distinguishable .
✗  Red PTM	✓  Green PTM			

PLANNING FOR PRODUCTION

The following pages showcase a plan for the production process of my *Phone Safe*. The details include in the plan include: equipment needed, description of the process, estimated time required, and the quality control and health and safety measures.

C5

STAGE NUMBER	PART OR COMPONENT	EQUIPMENT NEEDED	DESCRIPTION OF PROCESS	TIME (MIN)	QUALITY CONTROL MEASURES + HEALTH AND SAFETY
1	Circuit	- Screwdriver - Magnifying Glass - Cable Stripper - Soldering Iron - Solder Wire	- Using a cable stripper, remove the outer sheath from the ends of each wire - Match the corresponding wires together and join them using a screw type wire connector - Screw down each terminal of the connector using a screw driver - Connect the circuit to other components using solder wire and a soldering iron. Use the magnifying glass for a closer view while soldering - Set the circuit locking time to 1 minute, and test circuit using a voltmeter	180	- Beware of hot soldering iron and solder wire - Wear safety goggles to protect eyes from any solder wire splattering - Wear protective footwear (covered-toes) - Make sure soldering iron is kept on stand when not in use - Ensure that all the wires are slotted in securely - Keep water away when testing circuit with voltmeter
2	Body	- Fusion 360 - Adobe Illustrator - CNC Milling Machine - Wood Adhesive - Disc Sander - Sanding Paper - Sanding Block - Disc Sander	- Using Fusion 360, design the product including it's body pieces and components - Transfer the file onto Adobe Illustrator, and then using a CNC milling machine, cut the wood housing - Body Pieces x4 - Base - Lids: Circuit Compartment Lid, Phone Compartment Lid - Join the 4 body pieces together using wood adhesive - Sand the body using a sanding block, sanding paper, and disc sander	300	- Make sure that fusion 360 drawing is made with accurate dimensions CNC Milling Machine should be operated by a teacher or technician only - Wear safety goggles and protective footwear (covered-toes) as wood adhesive may contain formaldehyde (toxic material) - Do not use excess wood adhesive and it will be visible in the final product - Apply wood adhesive evenly - Wear dust mask when sanding - When using disc sander, make sure sanding motion is away from you and that hair is tied - Sand until product is smooth in texture
3	Base	Hand Drill	- Mark out the position of 4 holes with these measurements (mm): - Distance from edge: 6 - Distance between top and bottom holes: 138 - Distance between holes on sides: 178 - Using a hand drill, create 4 countersunk holes and then 4 pilot holes in the base with these measurements (mm): - Diameter of hole: 6 - Size of drill bit: 6 - Using the hand drill, drive 4 3.8mm screws into the base to join the base with the wood body	10	- Use a sharp pencil when marking for increased accuracy - Wear safety goggles - Maintain adequate ventilation - Keep a firm hand when drilling to keep hand drill from "wandering"
4	Compartment Lids	Hand Drill	<u>CIRCUIT Compartment Lid</u> - Mark out the position of a hole for the PTM switch to be placed into, with these measurements (mm): - Distance from edge (right side): 66 - Distance from top: 39 - Using a hand drill, create a countersunk hole and then create a pilot hole using these measurements (mm): - Diameter: 6 - Size of drill bit: 6	95	- Use a sharp pencil when marking for increased accuracy - Wear safety goggles - Maintain adequate ventilation - Keep a firm hand when drilling to keep hand drill from "wandering"

STAGE NUMBER	PART OR COMPONENT	EQUIPMENT NEEDED	DESCRIPTION OF PROCESS	TIME (MIN)	QUALITY CONTROL MEASURES + HEALTH AND SAFETY
4	Compartment Lids	Hand Drill	- Mark out the position of 4 holes with these measurements (mm): - Distance from edge: 6 - Distance between outer holes: 178 - Distance between inner holes: 78 - Vertical distance between outer and inner holes: 34 - Using a hand drill, create 4 countersunk holes and then 4 pilot holes in the base with these measurements (mm): - Diameter: 6 - Size of drill bit: 6 - Set circuit locking time to 1 hour - Using the hand drill, drive 4 3.8mm screws to join the circuit compartment lid with the wood body PHONE Compartment Lid - Mark out the position of 8 holes on the phone compartment lid and body piece 1 with the measurements (mm) in the diagram for the hinges to be inserted: - Using a hand drill, create 8 countersunk holes and then 8 pilot holes with these measurements (mm): - Diameter: 1.75 - Size of drill bit: 1.75 - Using the hand drill, drive 8 1.75mm screws, Joining the lid and wood body with hinges 		Refer to previous page
5	Solenoid	- Hand Drill - Coping Saw - Wood Adhesive - Digital Vernier Calliper	Solenoid SLOT - Fit the solenoid into the solenoid slot (body piece 1 & 2) Solenoid BORE - Using a digital vernier calliper, measure dimensions of solenoid Mark out measurements on small piece of teak wood - Using a coping saw, cut the small piece of teak wood into an accurate size, matching these dimensions (mm): - Length:18 - Width:10 - Height:17 - Using a digital vernier calliper, measure dimensions of solenoid latch (to ensure that the hole is a suitable size) - Mark out measurements on small piece of teak wood - Using a hand drill, drill a hole with an 11mm diameter, halfway - Using wood adhesive, glue the solenoid bore to the phone compartment lid	60	- Use a sharp pencil when marking for increased accuracy Coping saw to be used in presence of a teacher or technician - Keep a firm hand when sawing to keep coping saw from “wandering” - Wear safety goggles and protective footwear (covered-toes) as wood adhesive may contain formaldehyde (toxic material) - Do not use excess wood adhesive and it will be visible in the final product - Apply wood adhesive evenly - Maintain adequate ventilation

STAGE NUMBER	PART OR COMPONENT	EQUIPMENT NEEDED	DESCRIPTION OF PROCESS	TIME (MIN)	QUALITY CONTROL MEASURES + HEALTH AND SAFETY
6	USB Hole	- Digital Vernier Calliper - Hand Drill	- Using a digital vernier calliper, measure diameter of USB wire Mark out dimensions on body piece 4 using these measurements (mm): - Distance from edge (closest to front of product): 27 - Distance from top: 75 - Using a hand drill, create a countersunk hole and then a pilot hole with these measurements (mm); - Diameter: 4.5 - Size of drill bit: 4.5 - Insert USB wire through hole	5	- Wear safety goggles - Maintain adequate ventilation - Keep a firm hand when drilling to keep hand drill from “wandering”
7	Acrylic	- Adobe Illustrator - Laser Cutting Machine - Dark Brown Ink Pen - Epoxy Adhesive	Acrylic PIECE - Design acrylic piece on Adobe Illustrator with the engraved words “PHONE SAFE” - Using a laser cutting machine, cut a piece of matte white acrylic with the engraved letters - Using a dark brown ink pen, apply 3 coats of ink to colour the engraved letter (wait 15 mins between each coat) - Using epoxy adhesive, glue acrylic piece onto wood body (do not let it touch base or lid as it will stop the safe from being screwed open) Acrylic DISPLAY SCREEN - Design acrylic piece on Adobe Illustrator using these dimensions (mm) of rectangular hole in circuit compartment lid: - Length: 33 - Width: 25 - Using a laser cutting machine, cut a piece of clear acrylic from the design created - Fit the clear acrylic screen into the rectangular hole of the circuit compartment lid - make sure it is slotted in firmly	105	- After laser cutting, wait for fumes to wear off, then take out acrylic - Make sure extraction is turned on in room - Do not look at laser - When applying ink, avoid contact with skin and eyes - Wear safety goggles and protective footwear (covered-toes) as wood adhesive may contain formaldehyde (toxic material) - Do not use excess epoxy adhesive and it will be visible in the final product - Apply epoxy adhesive evenly
8	Sanding + Finishing	- Sanding Block - Sanding Paper - Teak Oil - Cloth	- Using sanding paper of 3 ratings (120-grit, 240-grit, 400-grit), sand the wood body - Apply 3 coats of teak oil to wood (wait 15 mins between each coat)	90	- Wear dust mask when sanding - Only sand the wood body, not any component parts - When applying teak oil, avoid contact with skin and eyes 3 coats of teak oil will allow for a smooth finish

PRESENTATION DRAWING

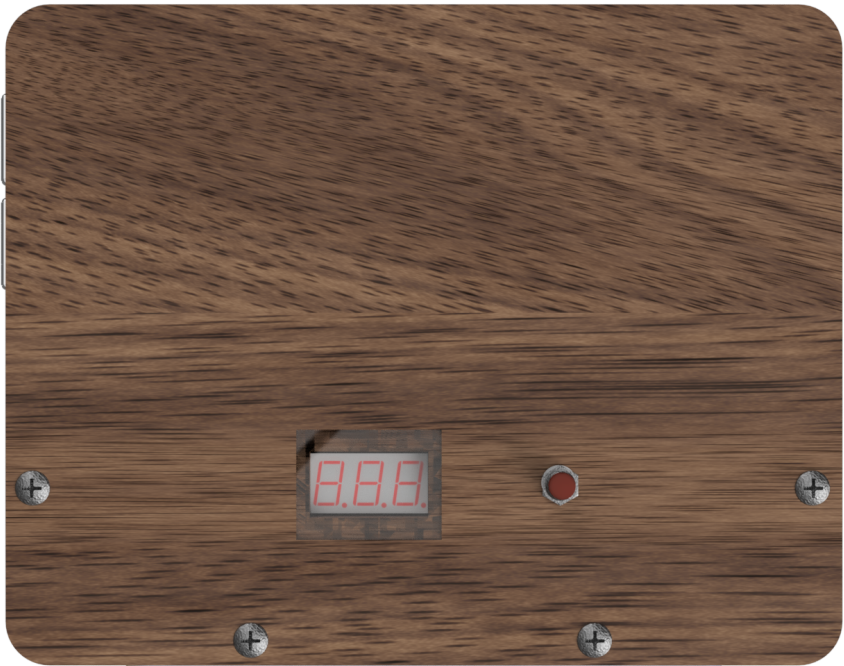
The following page shows my final product in different views, including: isometric view, top view, front view, right view, and left view.

- C1
- C2
- C3
- C4
- C5
- C6
- C7

ISOMETRIC VIEW



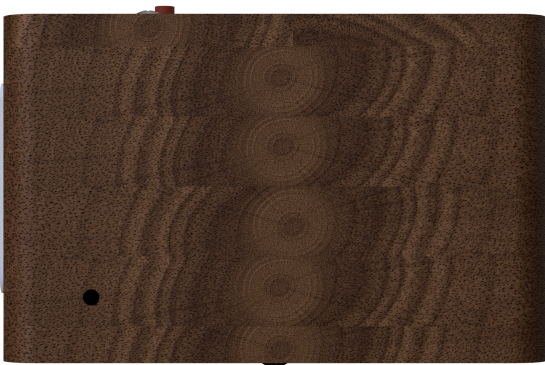
TOP VIEW



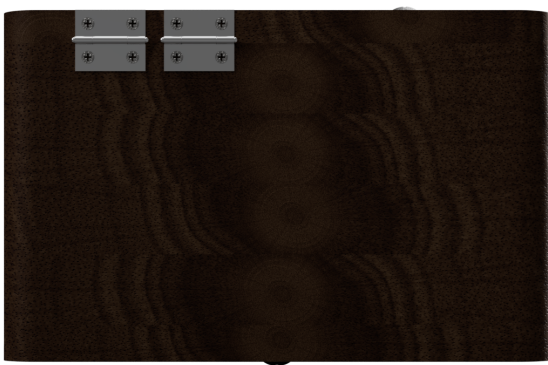
FRONT VIEW



RIGHT VIEW



LEFT VIEW

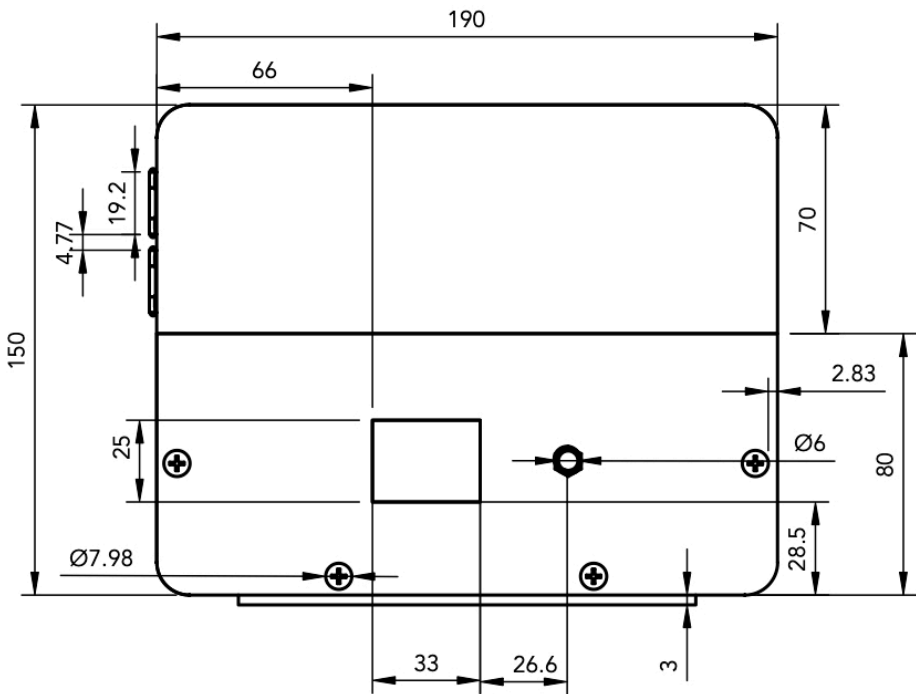


ORTHOGRAPHIC DRAWING - FINAL PRODUCT

The following page shows the orthographic drawing of my final product in different view, including: top view, isometric view, front view, and side view.

- C1
- C2
- C3
- C4
- C5
- C6
- C7

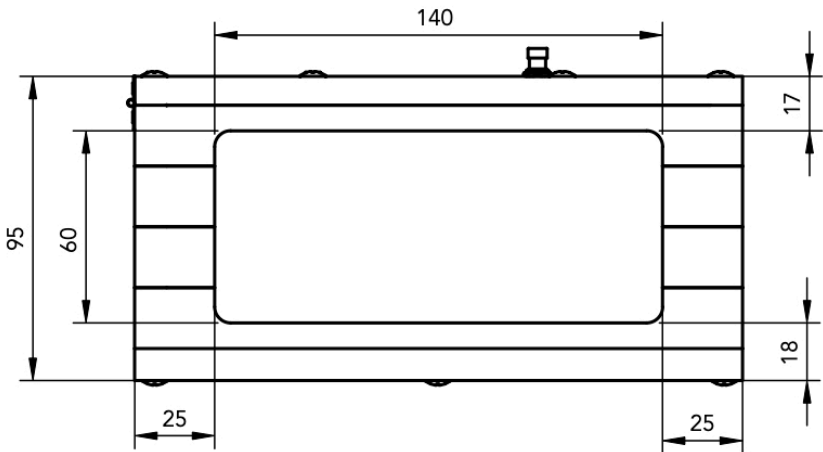
TOP VIEW



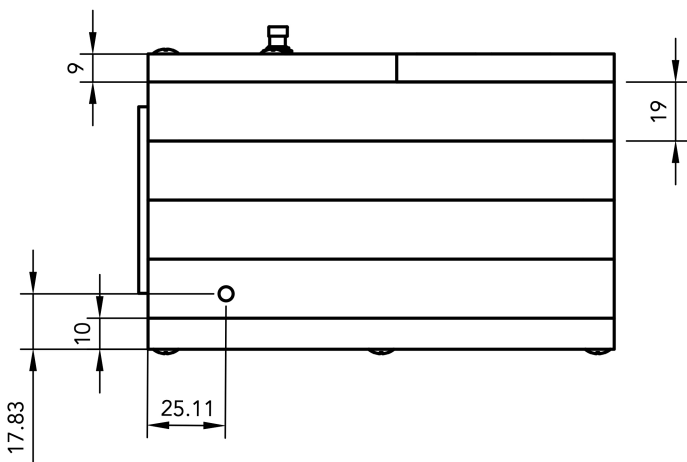
ISOMETRIC VIEW



FRONT VIEW



SIDE VIEW

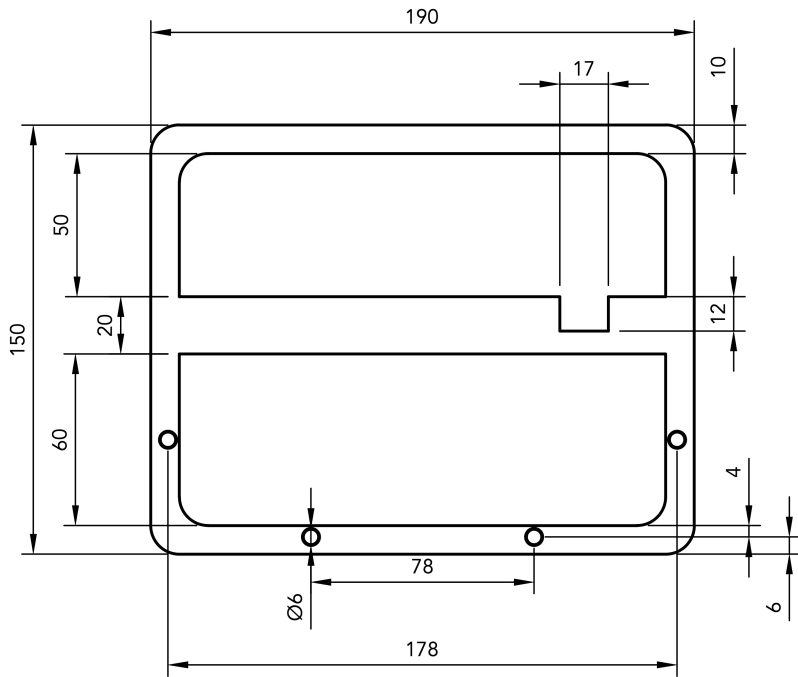


ORTHOGRAPHIC DRAWING - BODY PIECE 1

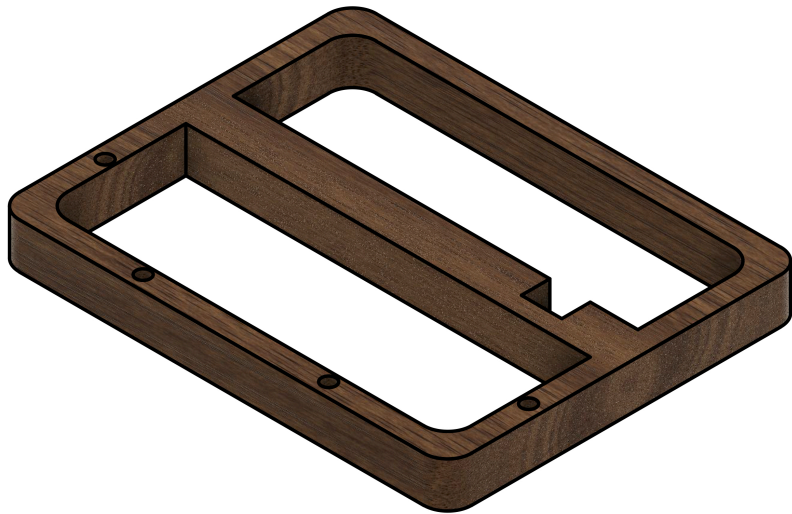
The following pages show orthographic drawings of each piece in my product. The drawing is presented through a top view, isometric view, front view and a side view.

- C1
- C2
- C3
- C4
- C5
- C6
- C7

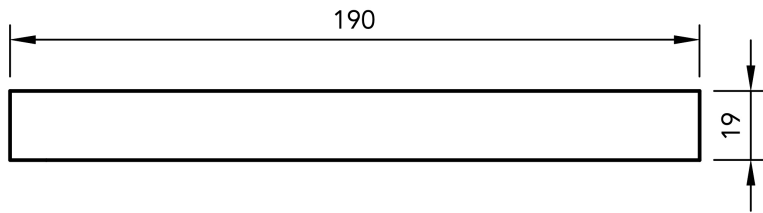
TOP VIEW



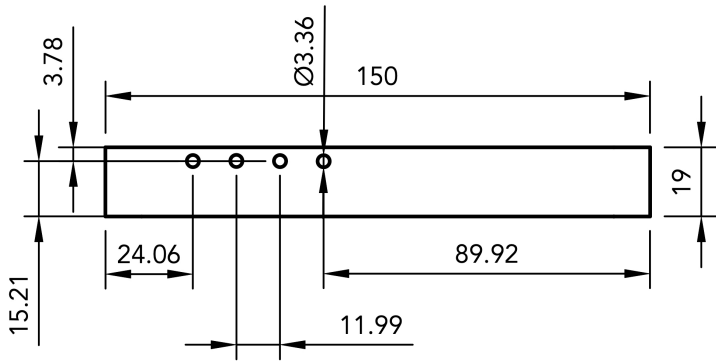
ISOMETRIC VIEW



FRONT VIEW



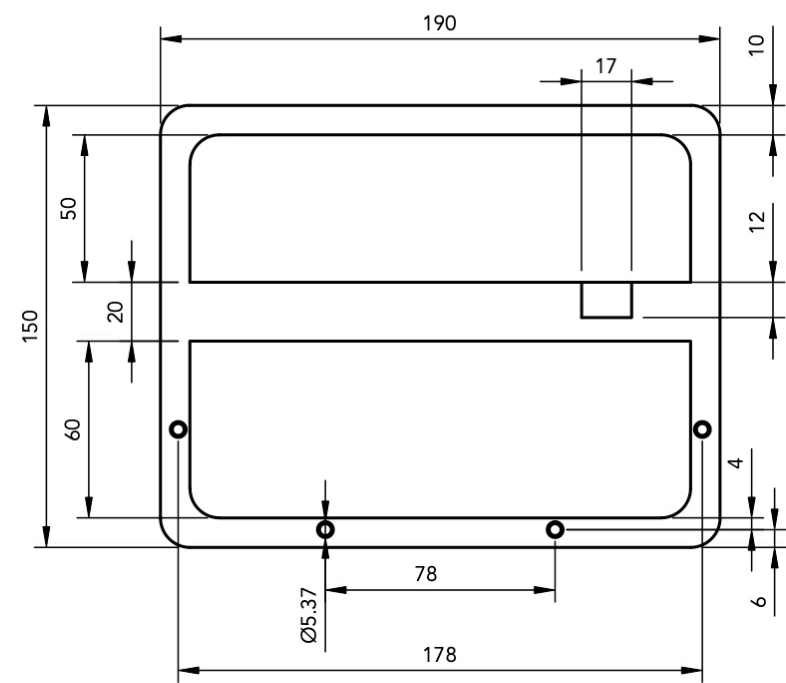
SIDE VIEW



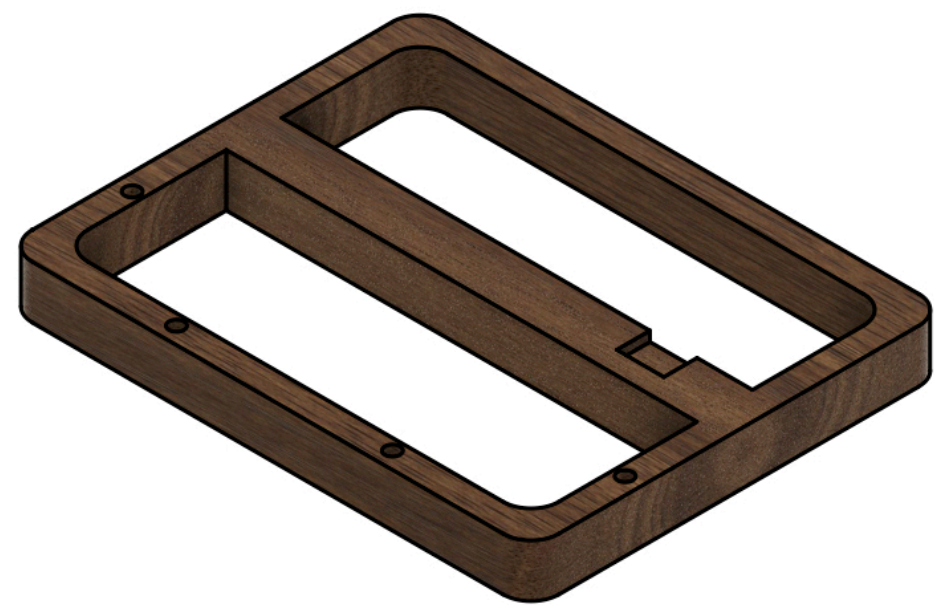
ORTHOGRAPHIC DRAWING - BODY PIECE 2

- C1
- C2
- C3
- C4
- C5
- C6
- C7

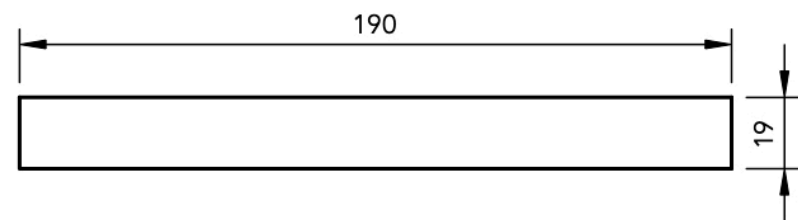
TOP VIEW



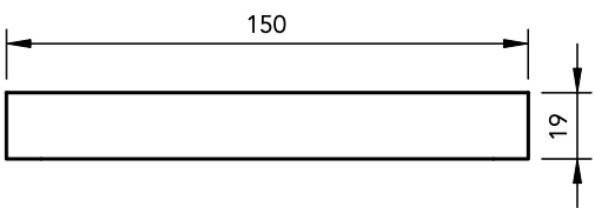
ISOMETRIC VIEW



FRONT VIEW



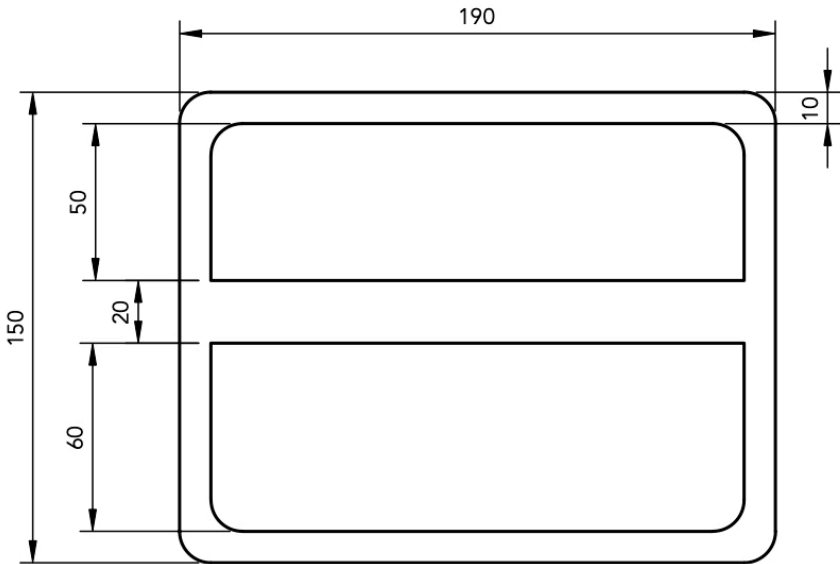
SIDE VIEW



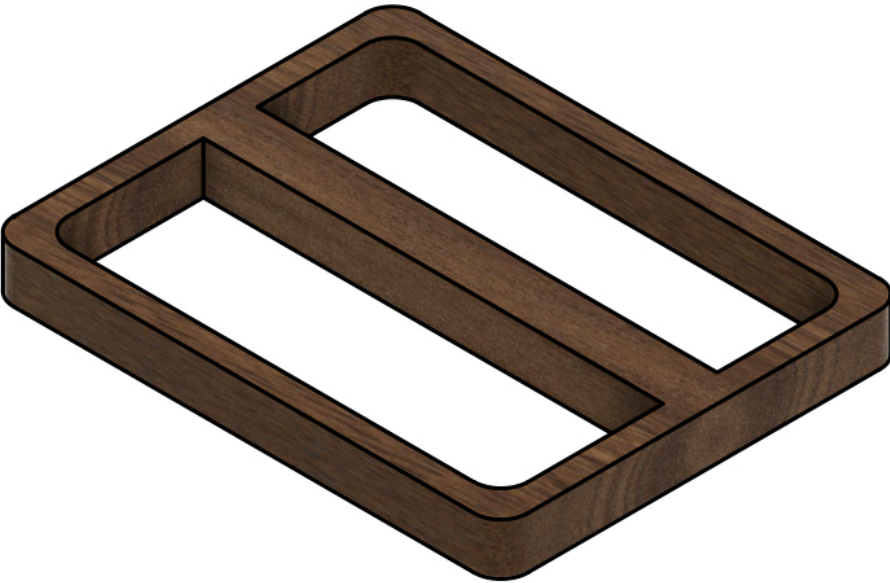
ORTHOGRAPHIC DRAWING - BODY PIECE 3

- C1
- C2
- C3
- C4
- C5
- C6
- C7

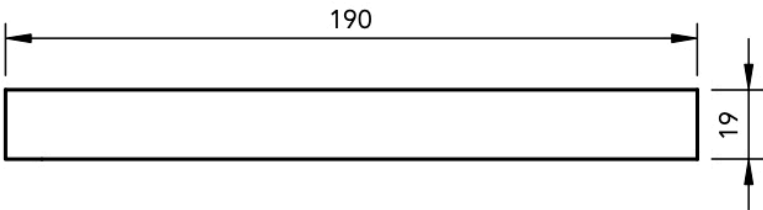
TOP VIEW



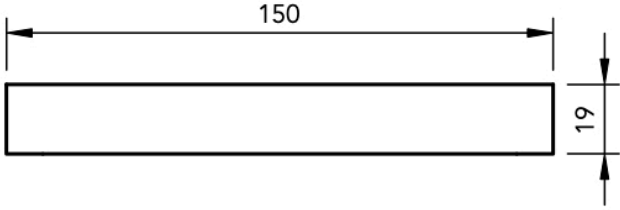
ISOMETRIC VIEW



FRONT VIEW



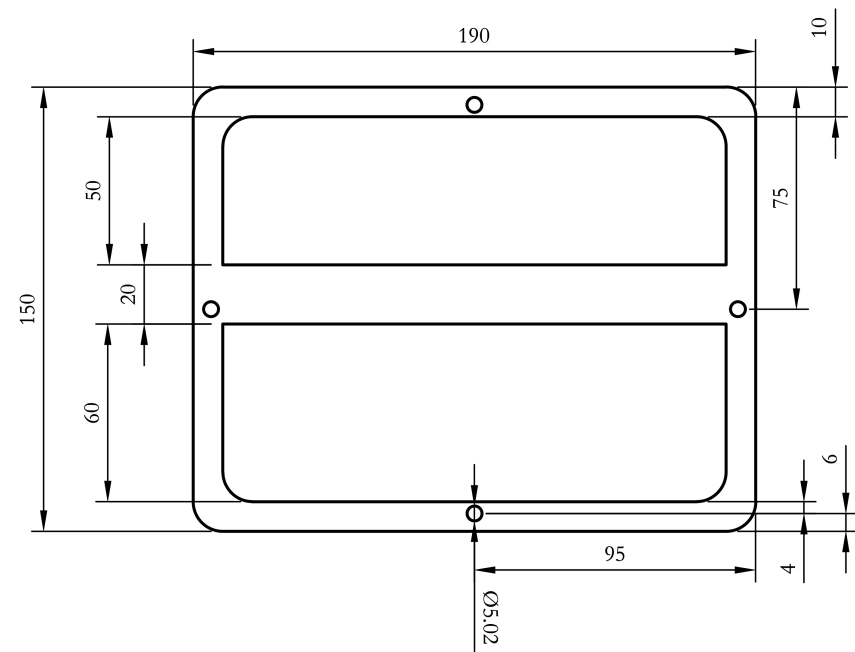
SIDE VIEW



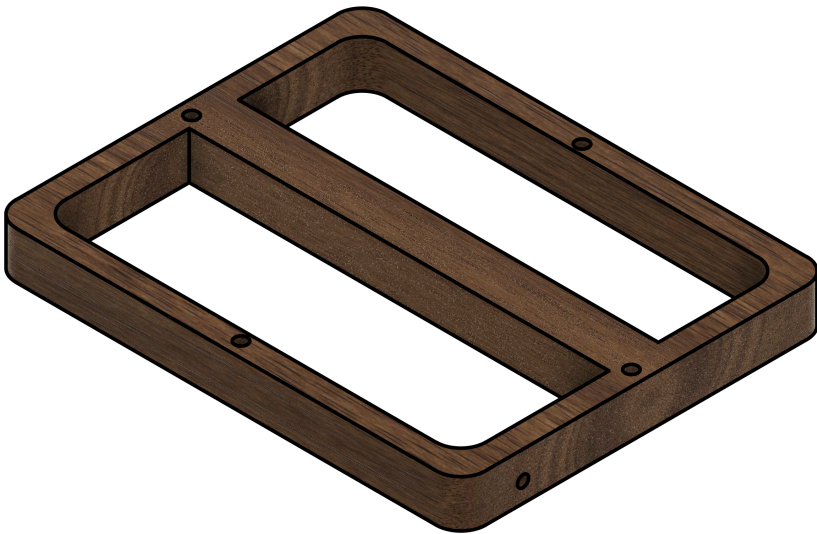
ORTHOGRAPHIC DRAWING - BODY PIECE 4

- C1
- C2
- C3
- C4
- C5
- C6
- C7

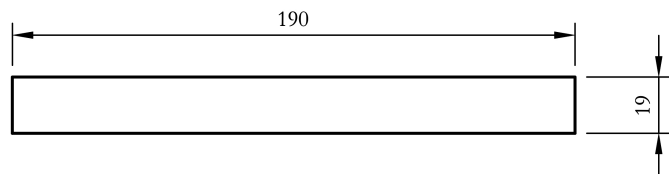
TOP VIEW



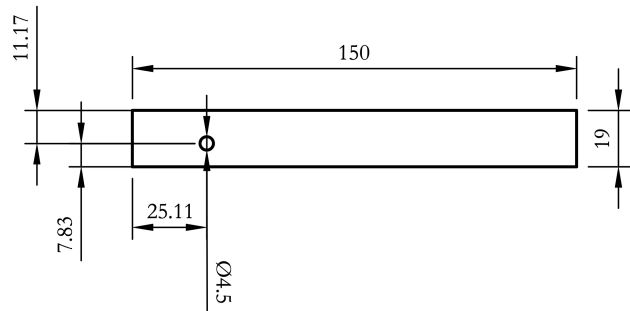
ISOMETRIC VIEW



FRONT VIEW



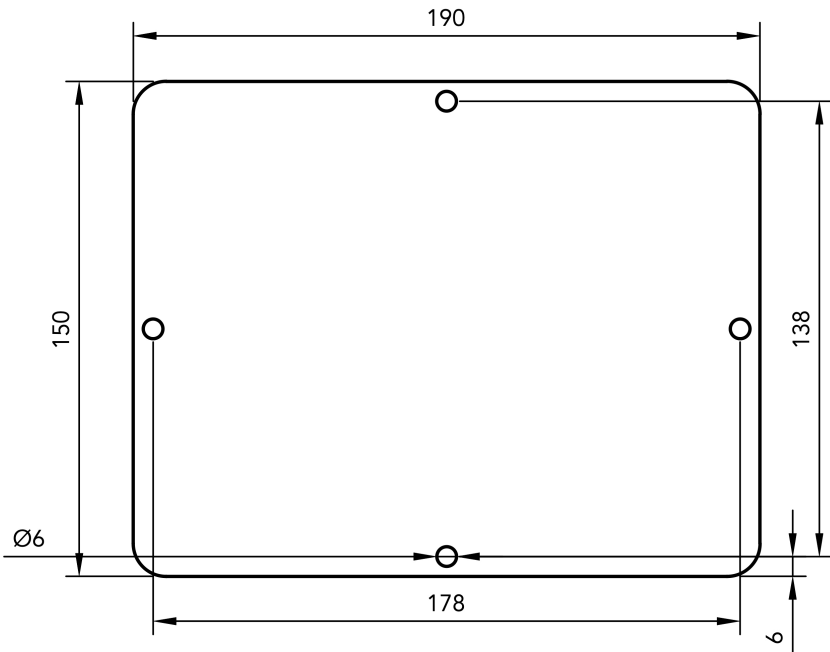
SIDE VIEW



ORTHOGRAPHIC DRAWING - BASE

- C1
- C2
- C3
- C4
- C5
- C6
- C7

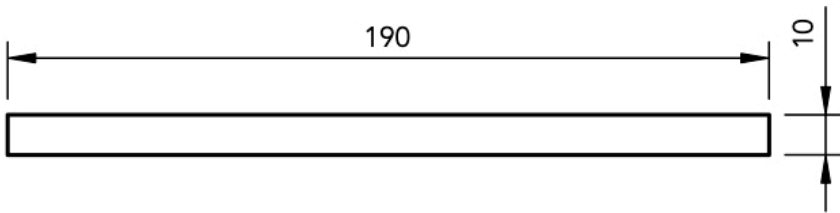
TOP VIEW



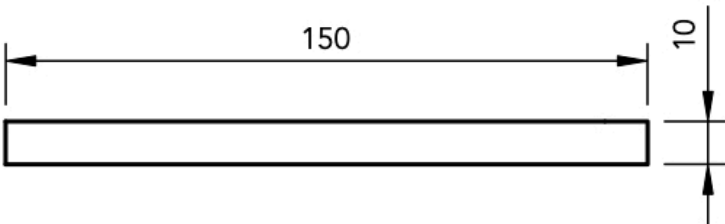
ISOMETRIC VIEW



FRONT VIEW



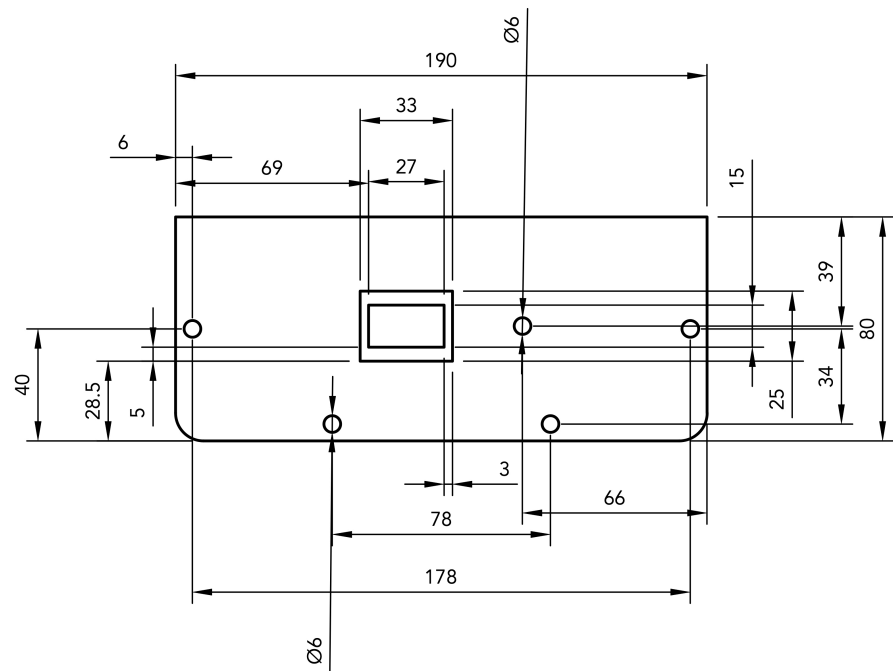
SIDE VIEW



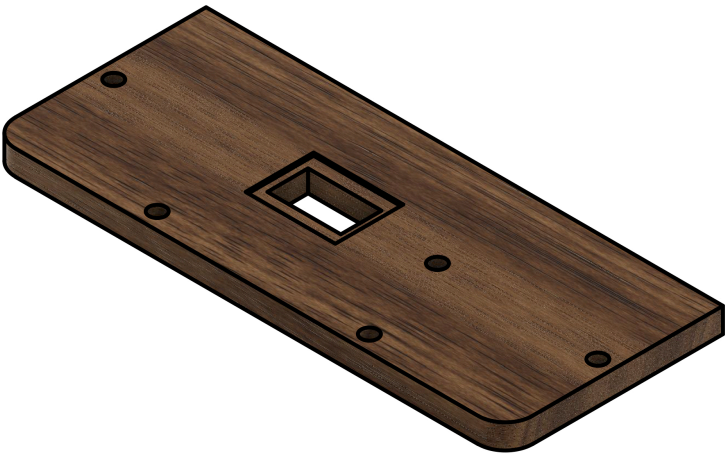
ORTHOGRAPHIC DRAWING - CIRCUIT COMPARTMENT LID

- C1
- C2
- C3
- C4
- C5
- C6
- C7

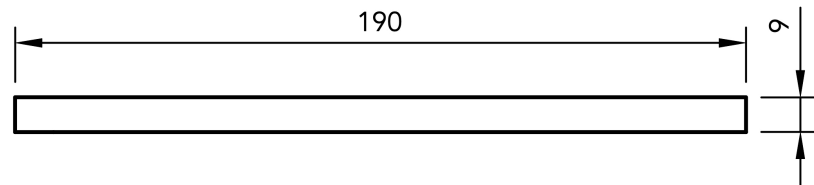
TOP VIEW



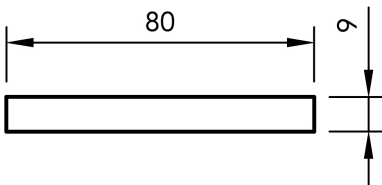
ISOMETRIC VIEW



FRONT VIEW



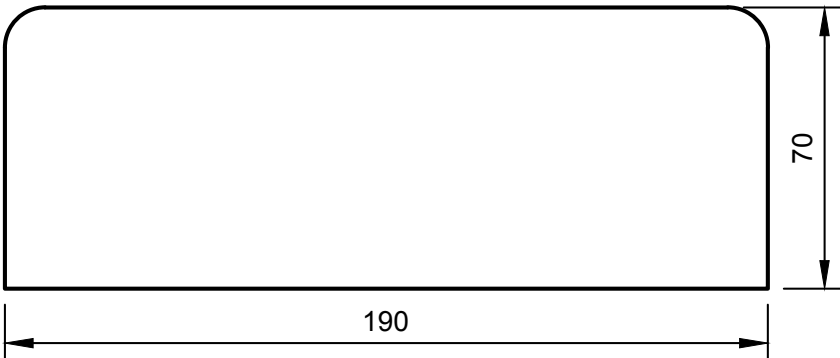
SIDE VIEW



ORTHOGRAPHIC DRAWING - PHONE COMPARTMENT LID

- C1
- C2
- C3
- C4
- C5
- C6
- C7

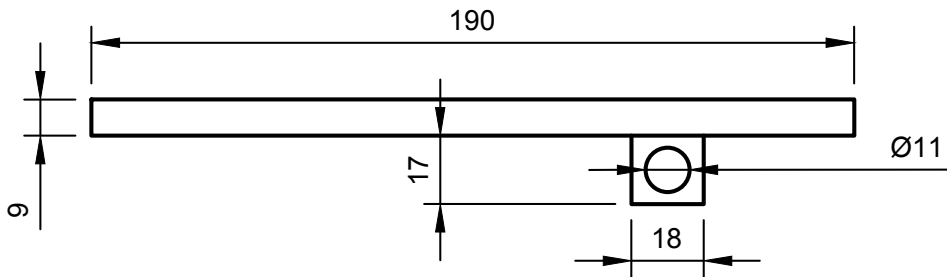
TOP VIEW



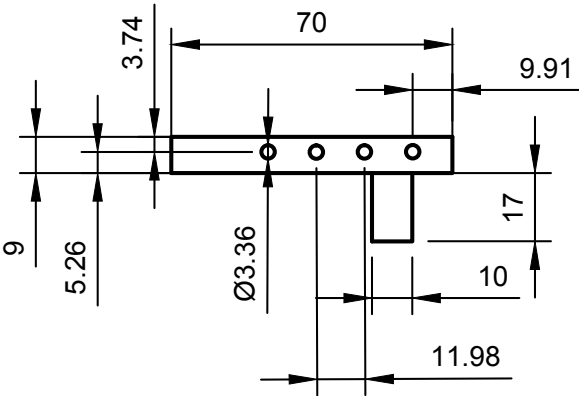
ISOMETRIC VIEW



FRONT VIEW



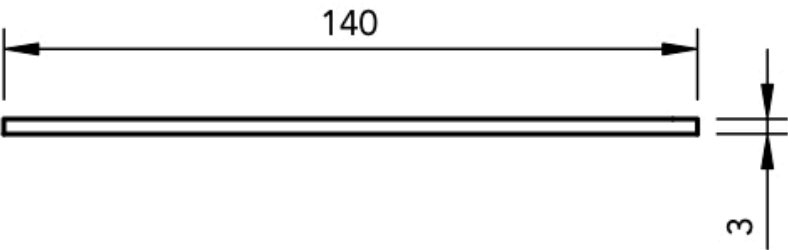
SIDE VIEW



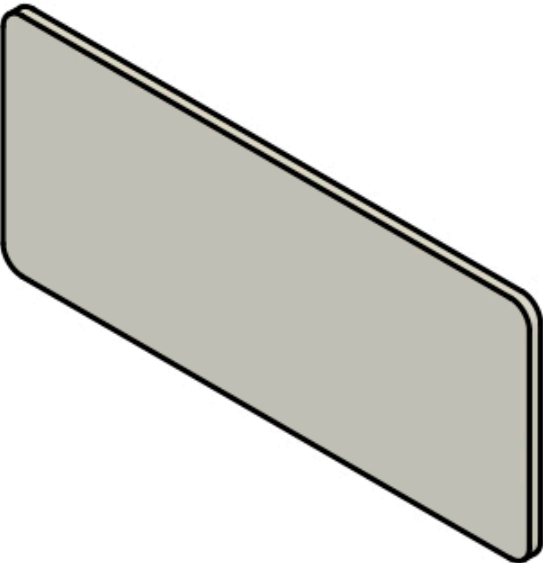
ORTHOGRAPHIC DRAWING - ACRYLIC PIECE

- C1
- C2
- C3
- C4
- C5
- C6
- C7

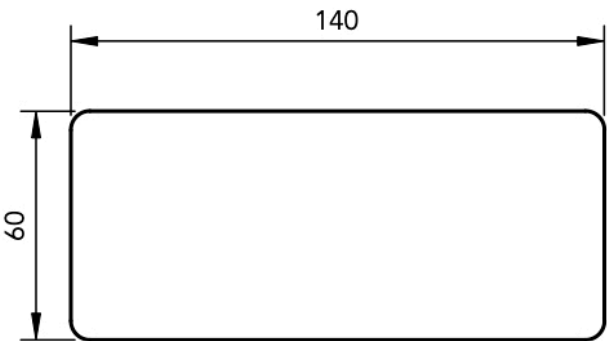
TOP VIEW



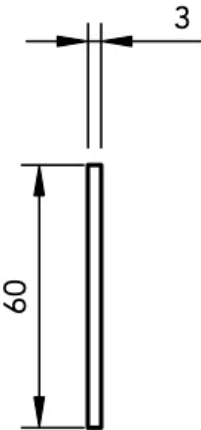
ISOMETRIC VIEW



FRONT VIEW



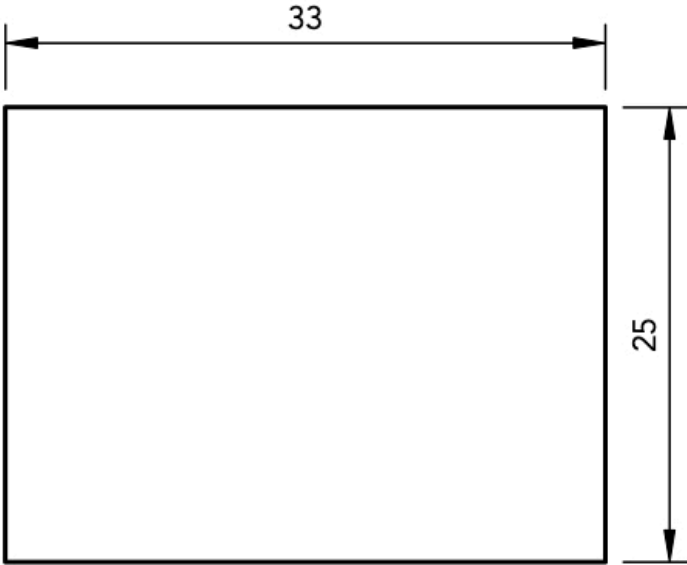
SIDE VIEW



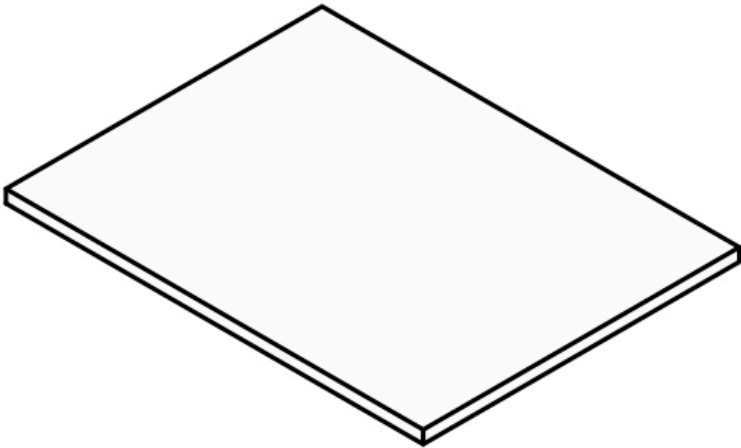
ORTHOGRAPHIC DRAWING - ACRYLIC SCREEN

- C1
- C2
- C3
- C4
- C5
- C6
- C7

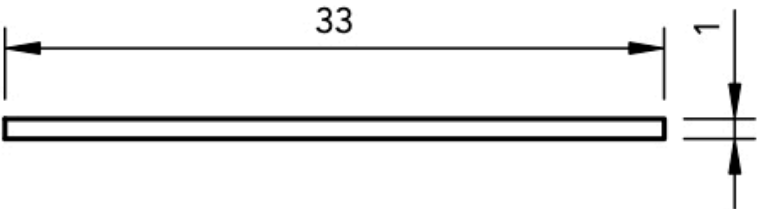
TOP VIEW



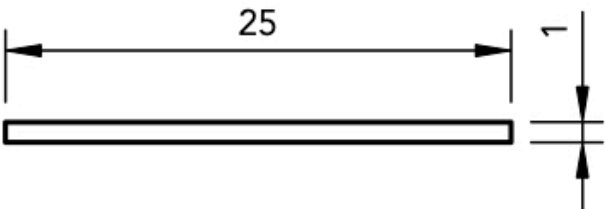
ISOMETRIC VIEW



FRONT VIEW



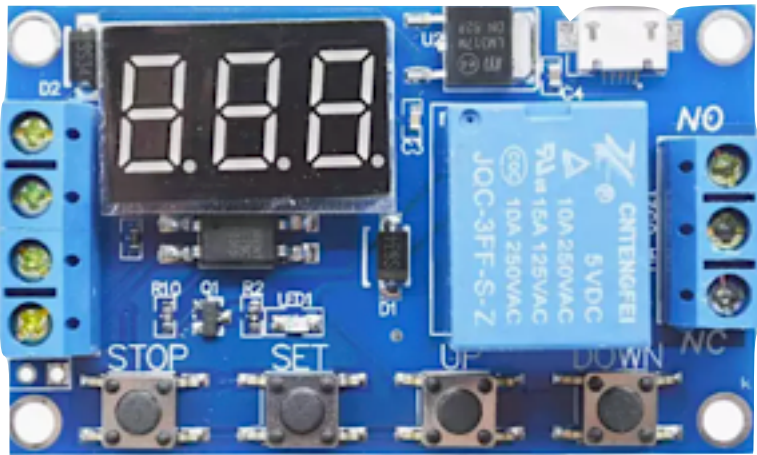
SIDE VIEW



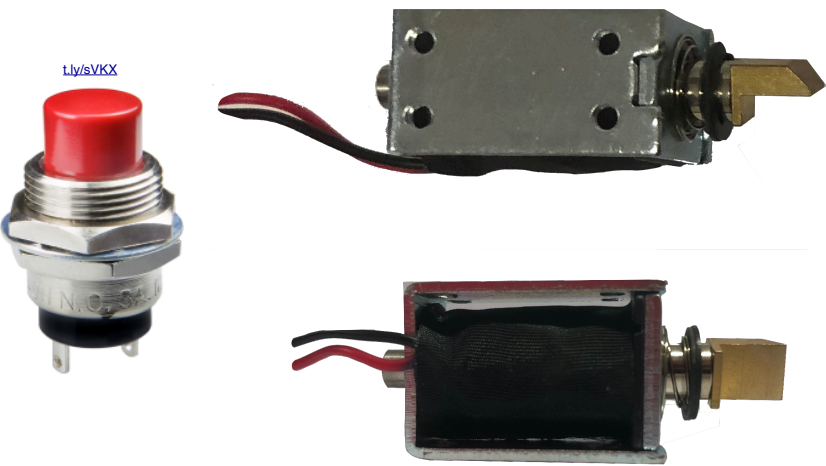
COMPONENTS

The following page shows a top view and isometric view of the components in my product.

CIRCUIT



SOLENOID AND SWITCH



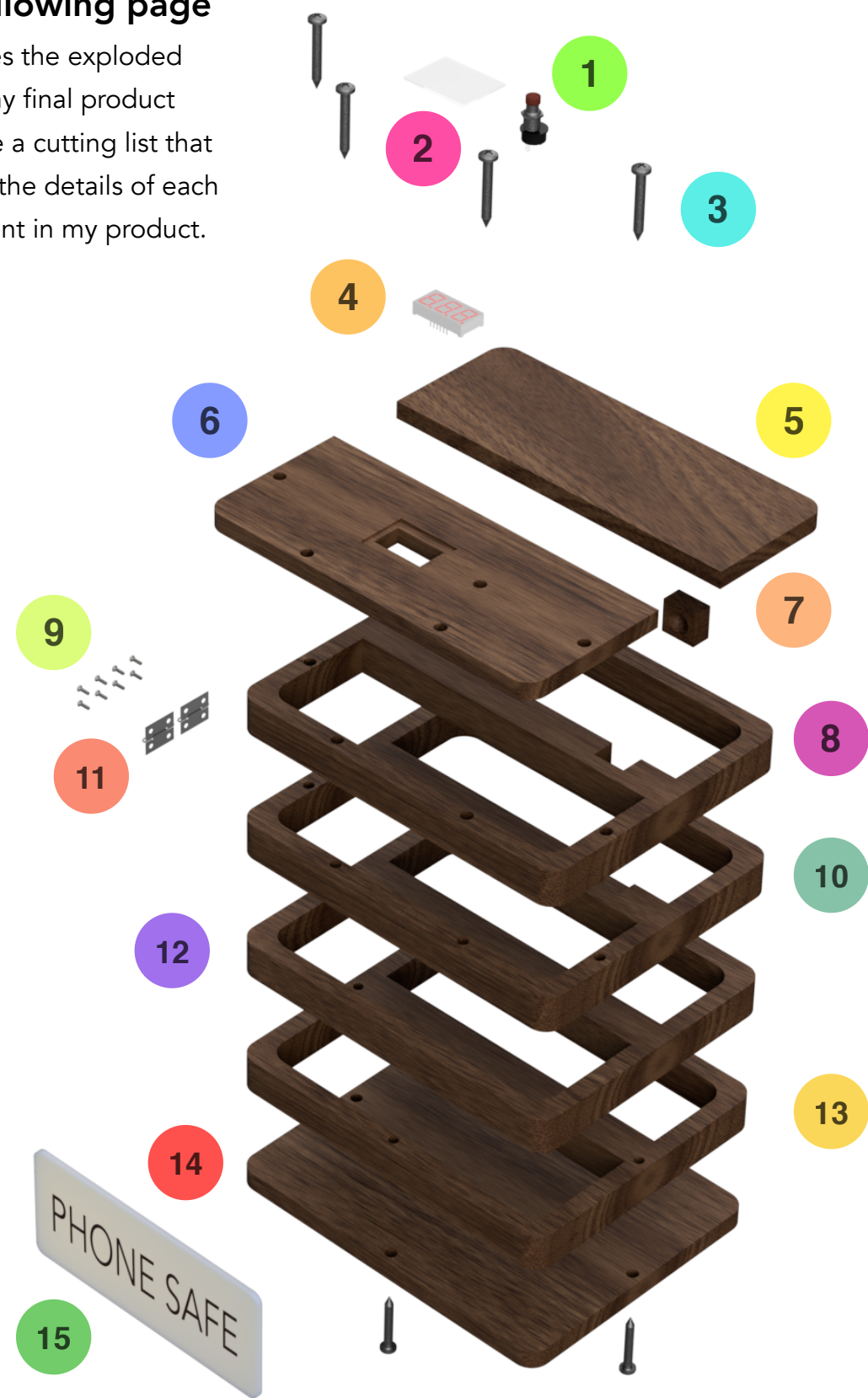
USB CABLE



- C1
- C2
- C3
- C4
- C5
- C6
- C7

RENDERED EXPLODED VIEW & CUTTING LIST

The following page showcases the exploded view of my final product alongside a cutting list that specifies the details of each component in my product.



COMPONENT	MATERIAL	DIMENSIONS (mm)	FINISHING	QUANTITY
1 MOMENTARY PTM SWITCH	Bakelite: Thermo-setting Plastic	Diameter: 8.75 Length:	None	1
2 DISPLAY SCREEN	Clear Acrylic	Length: 33 Width: 25 Height: 1	None	1
3 3.8mm CROSS HEAD SCREWS	Low Carbon Steel	Diameter: 3.84	None	4
4 7-SEGMENT DISPLAY	LEDs, VFDs, electrochromic display	Length: 19 Width: 12 Height: 10	None	1
5 PHONE COMPARTMENT LID	Teak	Length: 190 Width: 80 Height: 9	Teak Oil	1
6 CIRCUIT COMPARTMENT LID	Teak	Length: 190 Width: 70 Height: 9	Teak Oil	1
7 SOLENOID BORE	Teak	Length: 18 Width: 10 Height: 17	Teak Oil	1
8 BODY PIECE 1	Teak	Length: 190 Width: 150 Height: 19	Teak Oil	1
9 1.75mm CROSS HEAD SCREWS	Low Carbon Steel	Diameter: 1.75	None	8
10 BODY PIECE 2	Teak	Length: 190 Width: 150 Height: 19	Teak Oil	1
11 BUTT HINGES	Aluminium	Length: 25 Width: 30 Height: 20	None	2
12 BODY PIECE 3	Teak	Length: 190 Width: 150 Height: 19	Teak Oil	1
13 BODY PIECE 4	Teak	Length: 190 Width: 150 Height: 19	Teak Oil	1
14 BASE	Teak	Length: 190 Width: 150 Height: 10	Teak Oil	1
15 ACRYLIC PIECE	Matte White Acrylic	Length: 140 Width: 60 Height: 30	None	1

C1
C2
C3
C4
C5
C6
C7

PRODUCTION PROCESS

Materials Tools Processes

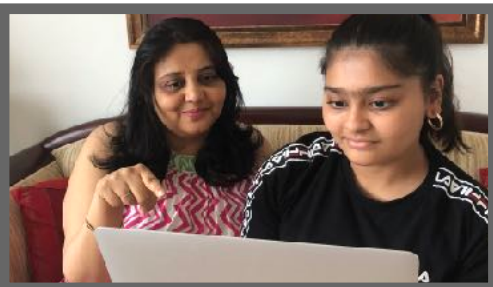
Safety and PPE (Personal Protective Equipment)

1

Preparation of Materials



The following pages showcases the production stages and processes I followed to create the my product. The process includes six key stages.



In order to select materials for my product, I had a **conversation** with my client. We looked over and discussed about the **types of wood** and **types of acrylic** that could be used for the phone safe.



Pine Wood



Teak Wood



Ash Wood

I showed my client pictures of **pine wood**, **teak wood**, and **ash wood**. My client best liked **teak wood** as she felt the **darker brown** colour would **match** the **wooden furniture** in her bedroom.

ACRYLIC SELECTION



MATTE BLACK



GLOSS BLACK



MATTE WHITE



GLOSS WHITE

I showed my client pictures of **matte black**, **gloss black**, **matte white**, and **gloss white acrylic**. My client felt that black would **not** match the dark brown colour of the teak wood and that it would seem **out of place** with the overall **aesthetic** of the **bedroom**. Nety **liked** the idea of **white acrylic** being on the front of the safe. She felt **gloss white** would be too **reflective**, thus chose **matte white**.

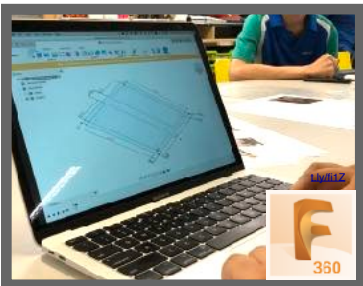
2

Setting, Measuring, Marking Out, Testing

Next, I **set, measured, marked, and tested** the various segments of my product.

SETTING PROCESS

By Using **Fusion 360**, I **designed** my product. I **added each part** of the wood body and components parts.



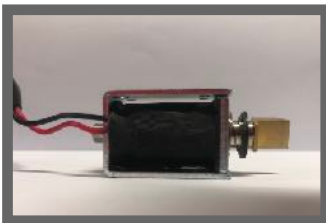
After **double-checking the dimensions** of the safe, I **transferred the file** onto **Adobe Illustrator**.



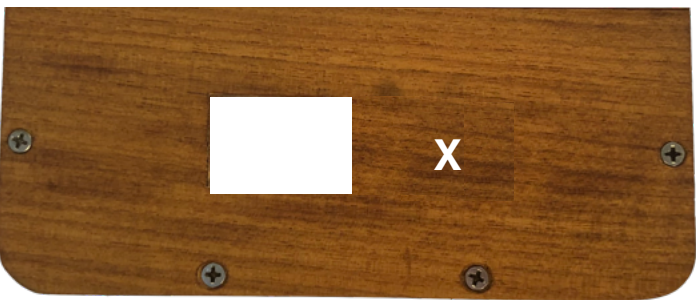
Using the **CNC Milling Machine**, I **cut** the body pieces, compartment lids, and base of my product. **My teacher assisted me in using the machine. We wore masks, safety goggles, and protective footwear.**

MEASURING PROCESS

Using a **digital vernier calliper**, I **measured** the size of my components.

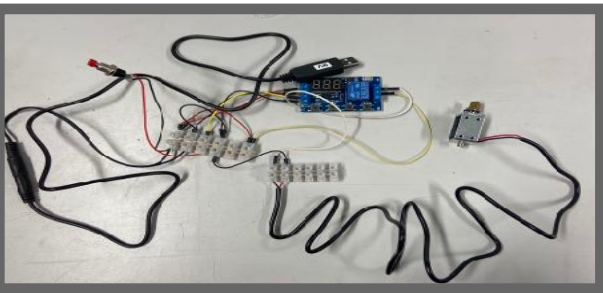


MARKING OUT PROCESS



Based on the **measurements** recorded in the previous step of the process, I **digitally marked out** the placement of my components. **After double checking the placement, I marked it** onto the circuit compartment lid using a **sharp pencil and ruler**. This allowed me to better **visualise** what my **final product** would look like.

TEST CIRCUIT



After having **soldered** my circuit using **solder wire** and a **soldering iron**, I **tested** it using a **voltmeter**. I **set the lock time of the safe to 1 minute** for testing purposes (**incase it did not open**). While testing my circuit, it was important for me to **keep my hands and my station dry** as any water presents **could create an electrical shock** when in **contact with my skin**.

PRODUCTION PROCESS

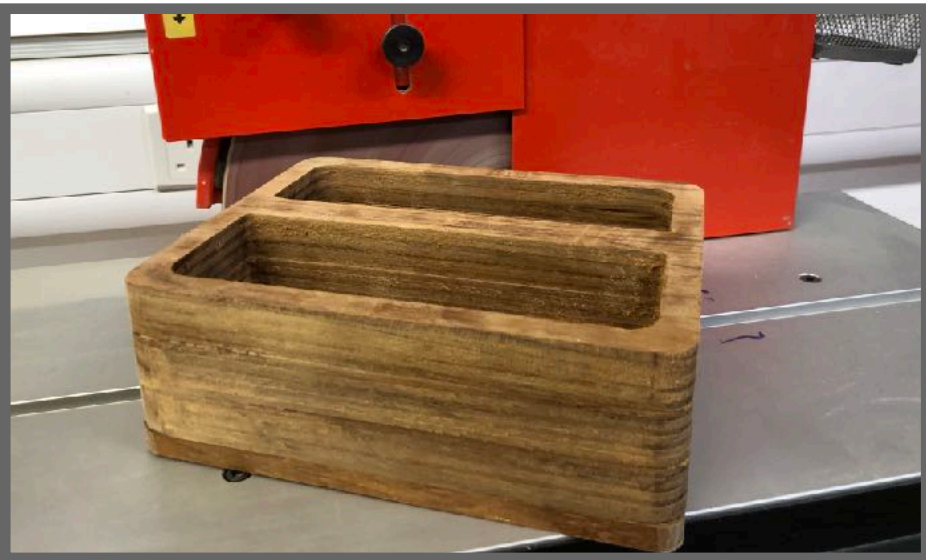
Materials	Tools	Processes
Safety and PPE (Personal Protective Equipment)		

3 Joining



Then, I joined the 4 body pieces using wood adhesive. I made sure to apply the adhesive evenly using a brush. I also regulated the amount I used in order to avoid any excess left on the edges.

Shaping



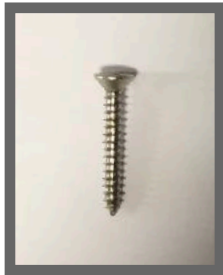
In order to shape my product, I used the disc sander. I carefully sanded my product to create filleted edges. While using the machine, I made sure my hair was tied up and that the sanding motion I used was away from my body.

I used a sanding block and sanding paper to smoothen the texture of the wood body. I used a variety of 3 types of sanding paper, including: 120-grit, 240-grit, and 400-grit. I wore a mask to avoid the inhalation of dust particles.



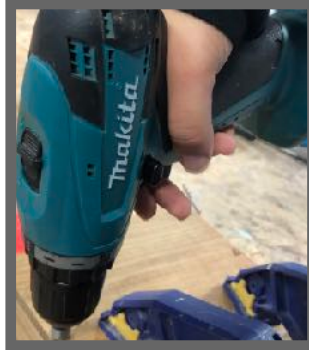
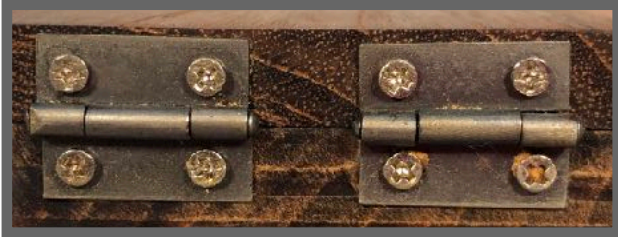
4

5 Assembly



I joined the base and circuit compartment lid to the wood body using 4 3.8mm cross-head screws. I needed to be extra careful of where my fingers are placed while using the hand drill.

I used 2 butt hinges to join the phone compartment lid to the wood body, allowing the lid to be opened and closed smoothly. Using the hand drill again, I drilled 8 holes with a 1.75mm diameter sized drill bit.



Using the hand drill, I drove 4 1.75mm screws into the phone compartment lid and 4 screws into body piece 1. I made sure to wear safety goggles to prevent any wood particles reaching my eye. I also kept a firm grip to avoid the hand drill from "wandering" on the wood.



Using a brush, I applied epoxy adhesive to glue the acrylic piece onto the front of my Phone Safe.

Finishing



I applied 3 coats of teak oil to the body of my product. I waited 15 minutes between each coat.

JUSTIFICATION OF MODIFICATIONS

The following page shows the modifications made through the production process, and the reasons as to why they were made.



1. Circuit Changed

The **original circuit** I was going to use was: t.ly/eQo4 I found a **new circuit** which I felt was more **suitable**: t.ly/pHQs. However it did not allow for a battery pack to be attached (now requires power source).

6. Screws

Instead of **gluing** the circuit compartment lid, I instead decided to **screw** it down. This allows for the safe to **opened** in case of an **emergency**.



t.ly/y49T

Hmm...wouldn't phone box mean more like...
t.ly/T4BU

8. Phone Safe



My client felt that **Phone Box** was a **confusing** title to give to the product. Nety suggested keeping the name **Phone Safe** instead. This name makes the **function** of the product clear while remaining **concise**.

3. Lids Made out of Wood

While planning to make the phone and circuit compartment lids out of **acrylic**, I found that it was **too difficult**. Hence, I instead made the lids out of **teak wood**.

FINAL PRODUCT

4. Acrylic Piece (Engraving)

I planned on having an **engraving** on my wood body, however, since I modified the **acrylic** lids to be **teak wood**, I **no** longer had any colours in my product that would complement the brown coloured furniture in Nety's bedroom. Thus, I decided to have an engraving on a piece of **white acrylic**.

2. Display Screen

The new circuit I decided to use has a maximum height higher than the display, and so the 7-segment-display does not reach the surface of the wood. Thus, I added an acrylic display screen for the 7-segment-display to still be visible.

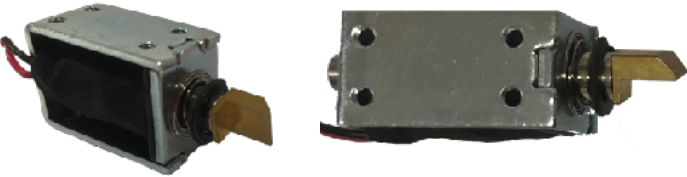


7. LED

I did **not** add an LED as I felt that having the display and one button would give a **neater, minimalistic** look.

5. Phone Compartment Lid (Solenoid Positioning)

Initially, the **position** of the **solenoid** was going to be next to the **acrylic handle** I planned on creating. However, in my final product, the **position** of the **solenoid** is **in between the two lids**. Therefore, the shape of my phone compartment lid has changed - it is not required to be **overhanging** anymore.



C1

C2

C3

C4

C5

C6

C7

PRODUCT REALISATION

The following page shows my final product.



- C1
- C2
- C3
- C4
- C5
- C6
- C7

FINAL PRODUCT IN INTENDED ENVIRONMENT

The following page showcases my final product in the design environment.



- C1
- C2
- C3
- C4
- C5
- C6
- C7



TESTING AND EVALUATION IN INTENDED ENVIRONMENT

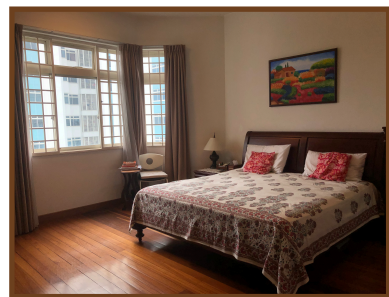
The following page shows the Phone Safe in the environment and the evaluation of whether it meets my client's wants and needs.

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"The product should be **lightweight** and **compact** to easily carry around and place on different furniture"



"The product should match the **traditional** and **classic style** of the bedroom"



A bit more modern and contemporary



My client carrying the product with ease



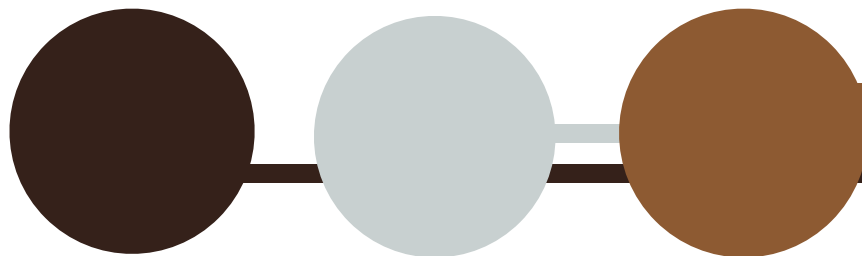
Fits well on bedside table



Lightweight - can be carried and placed on different pieces of furniture



"The product should **complement the brown colour** of the bedside table"



"The product should have an **element of wood** to conform with the furniture"



Teak Wood Body



Filleted Edges

"The product should not have any **sharp** edges as it may cause **scratches**"



"The product should have a **clear** or **white** coloured element"

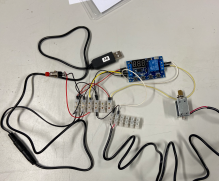


White Acrylic Piece

TESTING AND EVALUATION AGAINST THE SPECIFICATIONS

The following page shows an evaluation of my product in terms of whether it meets the specifications my client has described alongside photographic evidence for each category.

C7

SPECIFICATION POINT	CRITERIA	SATISFACTION OF CRITERIA	EVIDENCE
1 AESTHETICS	1.1 - The product must have a clear or white coloured element 1.2 - My product should match the traditional and classic style of the bedroom 1.3 - Colours should complement the dark brown furniture of the bedroom 1.4 - The product must look stylish	1.1 - The product has a clear acrylic display and a white acrylic piece 1.2 - Product does not entirely match the traditional and classic style of the bedroom 1.3 - White acrylic piece complements the dark brown furniture of the bedroom 1.4 - Client thinks product looks stylish	
2 COST	2.1 - The product must not cost more than \$40 2.2 - I must not spend more than \$30 in the production process 2.3 - My circuit should not cost more than \$10 2.4 - I will avoid buying excess materials	2.1 - Cost is below \$40 2.2 - Cost of production process is below \$30 2.3 - Cost of circuit is below \$10 2.4 - Sufficient amount of materials bought	
3 CUSTOMER (TARGET MARKET)	3.1 - My client is Nety Sahai , who wants to keep her sons's phone away from him while he is studying 3.2 - My target market is other parents trying to keep gadgets away from their children 3.3 - The product created must be an electronic phone safe 3.4 - Items placed inside my product should not be visible from the outside of the box, reducing the child's feeling of needing to look at the safe	3.1 - Product meets client's needs 3.2 - Meets needs of target market 3.3 - Phone safe is electronically controlled 3.4 - Items placed inside my product should not be visible from the outside of the box, reducing the child's feeling of needing to look at the safe	
4 ENVIRONMENT	4.1 - The products should not have sharp edges 4.2 - Safe should have an ability to open in an emergency situation	4.1 - Product has filleted edges 4.2 - In case of an emergency , safe can be screwed open from 2 openings	
5 SIZE	5.1 - Product must fit on the bedside table (Length: 24cm, Width: 45cm) and not take up more than 2/3 of the space 5.2 - Must fit the iPhone X inside (Length: 14cm, Width: 7.2cm, Depth: 7.7mm)	5.1 - Product fits on bedside table, within the measurements 5.2 - Phone fits in the safe	
6 SAFETY	6.1 - Must be lightweight to avoid any injuries due cause by the weight of the product	6.1 - Product is relatively lightweight	
7 FUNCTION	7.1 - Product must have a timer switch with LED's that display the timer countdown 7.2 - Must include a lock or solenoid which opens and closes the box 7.3 - Nety should be able to chose the time that the safe is locked for	7.1 - Product has a timer switch and display the timer countdown; does not have LED's (but client is fine with this) 7.2 - Includes a solenoid which opens and closes the box, however, safe is locked as default thus lid must be kept open or client must wait 1 hour for safe to unlock before use 7.3 - Circuit does not easily allow for time to be adjusted (lid has to be unscrewed for lock time to change - default time is 1 hour)	
8 MATERIALS	8.1 - Product should include an element of wood 8.2 - Material should be hard 8.3 - Material should be durable 8.4 - Material should be strong	8.1 - Product includes teak wood body 8.2 - teak wood is hard 8.3 - teak wood is durable 8.4 - teak wood is strong	
9 SUSTAINABILITY	9.1 - Materials used should be renewable 9.2 - Materials used should be eco-friendly 9.3 - Materials used should be recyclable	9.1 - teak wood is renewable 9.2 - teak wood is eco-friendly 9.3 - teak wood is recyclable	

PROPOSAL FOR FUTURE DEVELOPMENTS

The following page illustrates and describes specific modifications I could make to my product if I were to further develop it.

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Change Circuit

I could find a **better** circuit in terms of **practicality**, such as one that allows the 7-segment-display to **reach** the **surface** of the wood. I could also look for a circuit that has a **larger board** and **larger display**, as the **current** one is **quite small**. I also need to make sure that this new circuit does **not** function in a manner where the **default** state of the safe is to be **locked**.

LARGER BOARD AND DISPLAY

Balanced Colours

In order to maintain a **balance** between the **brown** and **white** elements of my product, I could modify body piece **2** and body piece **3** to be made from **white ABS plastic**. I could create these two pieces using a **3D printer**. This modification would make my product more **aesthetically pleasing**.

3D PRINTED WHITE ABS PLASTIC PIECES

Enhanced Function - Adjust Locking Time

After finding a circuit that is also **easier** to **operate**, I could add a **rotary switch** which will allow for my client to **adjust** the time that the box is **locked** for.

Acrylic Piece Positioning

Instead of having the acrylic piece on the front of the product, I could move it to the **top** of the **phone compartment lid**. This would make the engraving **more subtle** and **less jarring**.

MORE SUBTLE LESS JARRING

Teak Wood Handle

By adding a **handle**, it would be **easier** to **open** and **close** the safe. Moreover, as the **dark brown colour** of the **teak wood** **contrasts** the **white acrylic** piece, this modification would make the product more **aesthetically pleasing**.

ADD ROTARY SWITCH AND TEAK HANDLE



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C2

C3

C4

C5

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SCAN TO SEE THE PHONE
SAFE IN ACTION!